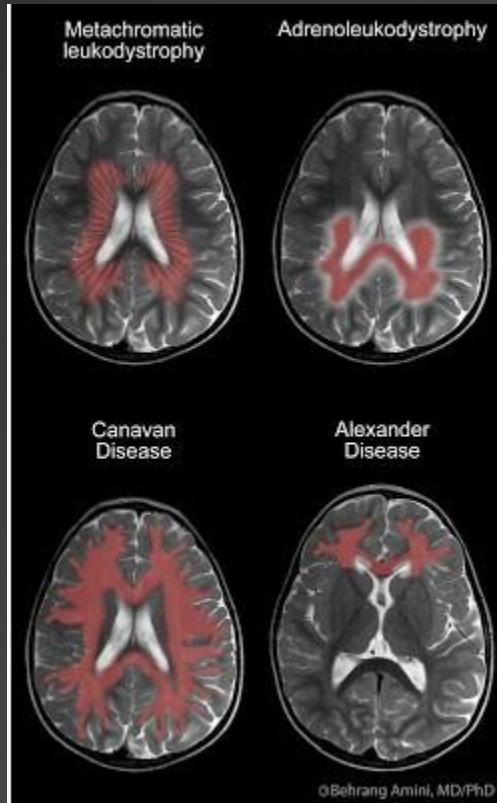
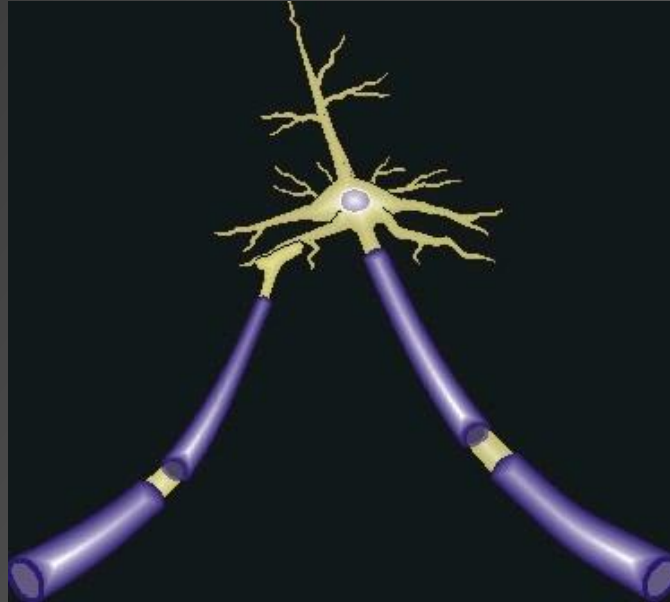


IMAGING OF WHITE MATTER DISEASES

DR NEHA BHANGDIYA



MYELINATION



BASIC PRINCIPLES OF MYELINATION ON MRI

- Unmyelinated white matter appears hypointense on T1W and hyperintense on T2W images.
- Myelinated WM appears hyperintense on T1W and hypointense on T2W images
- Increase in signal intensity on T1W images precede the decrease in signal intensity on T2W images
- Before the age of 6 months T1W images are more sensitive to the detection of myelination changes than the T2W images



POINTS TO REMEMBER

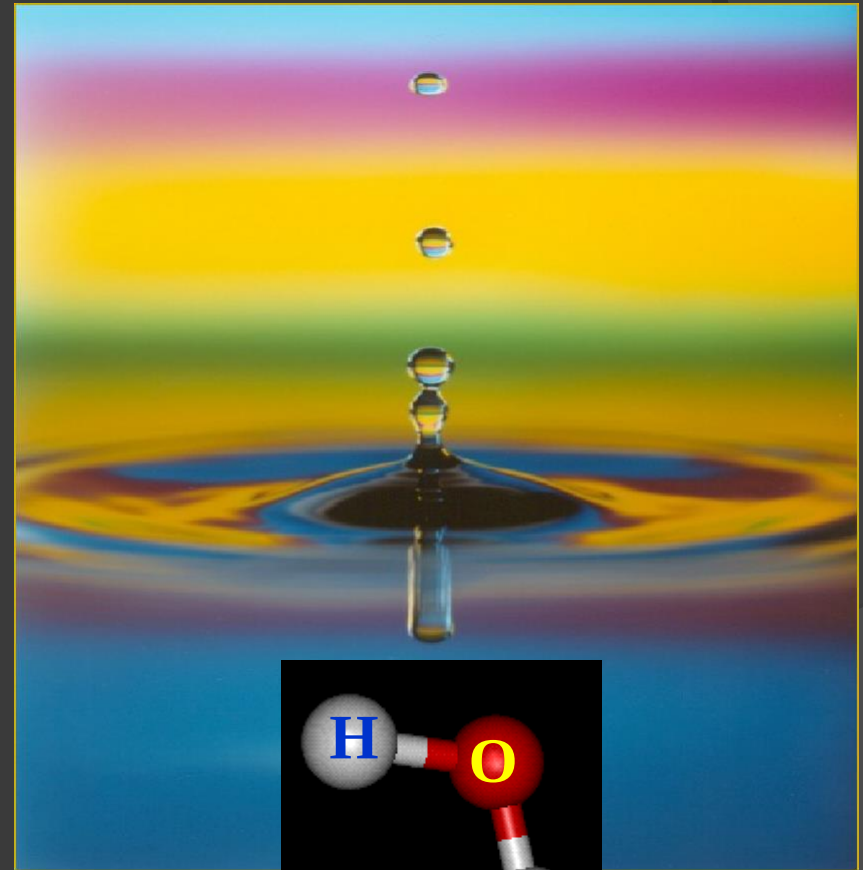
- T1W images are a better way of detecting the primary process of myelination
- T2 weighted images seem better in the evaluation of the associated change of water loss
- Even more heavily T1W imaging sequences such as inversion recovery sequences or SPIN ECHO sequences with even shorter TE and TR may prove to be even more sensitive in the detection of developing myelination

CHANGES IN T1 PRECEDE T2!

- Chemical changes in myelin development which affect the T1 contrast precede the chemical change that affects the T2 contrast
- The discrepancy is about 2 months in corpus callosum to 6-10 months in centrum semiovale

T1 BEST BEFORE 6 MONTHS

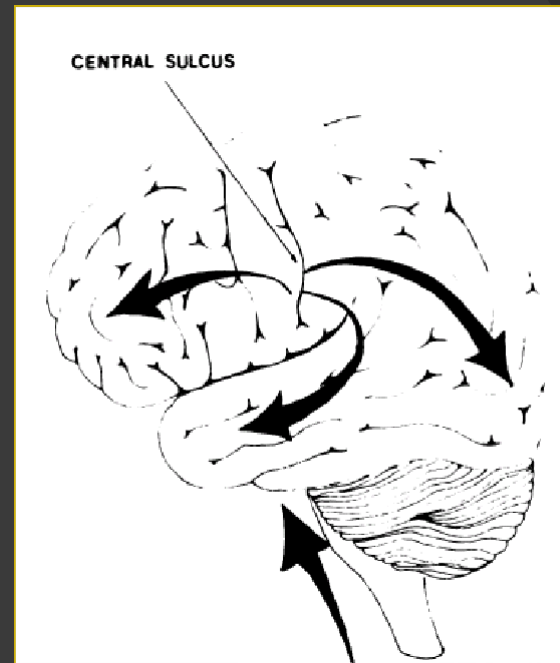
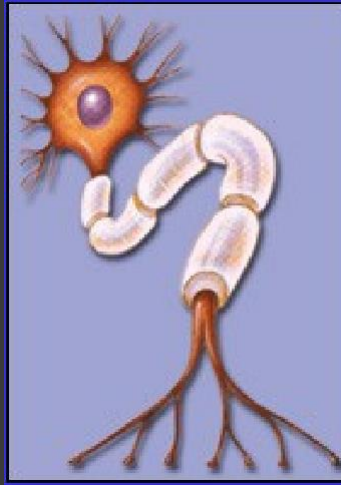
- T2 of the immature brain have relatively poor grey/white matter distinction due to **high water content** of the unmyelinated matter



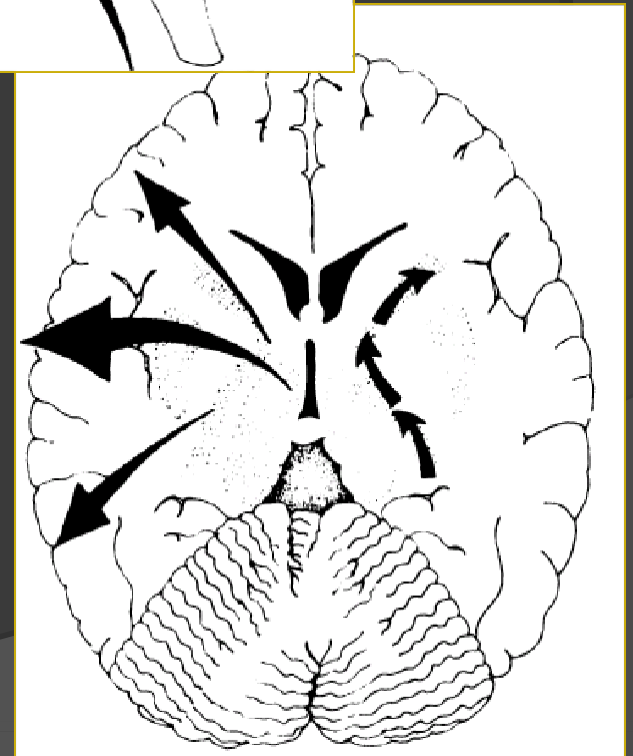
Progression of Myelination



MYELIN DEPOSITION



- Proximal pathways before distal
- Sensory before motor
- Central WM before peripheral
- Posterior before anterior



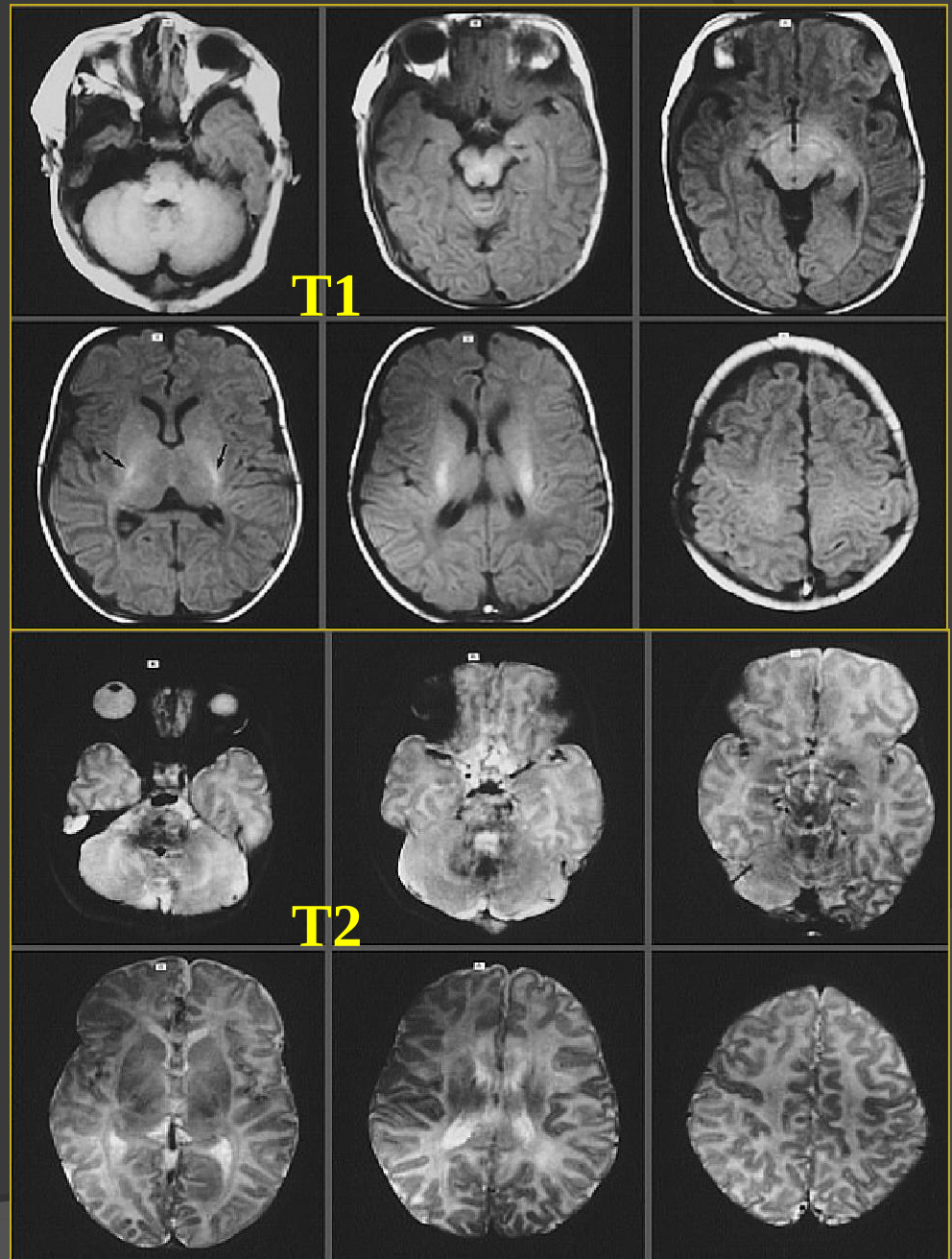
MYELINATION

- Predominantly a post-term process
- In pre-term neonates born at 30-36 weeks myelin is seen in the medulla, the dorsal aspect of the pons, the inferior cerebellar peduncles, the cerebellar nuclei and the posterior limb of the internal capsules



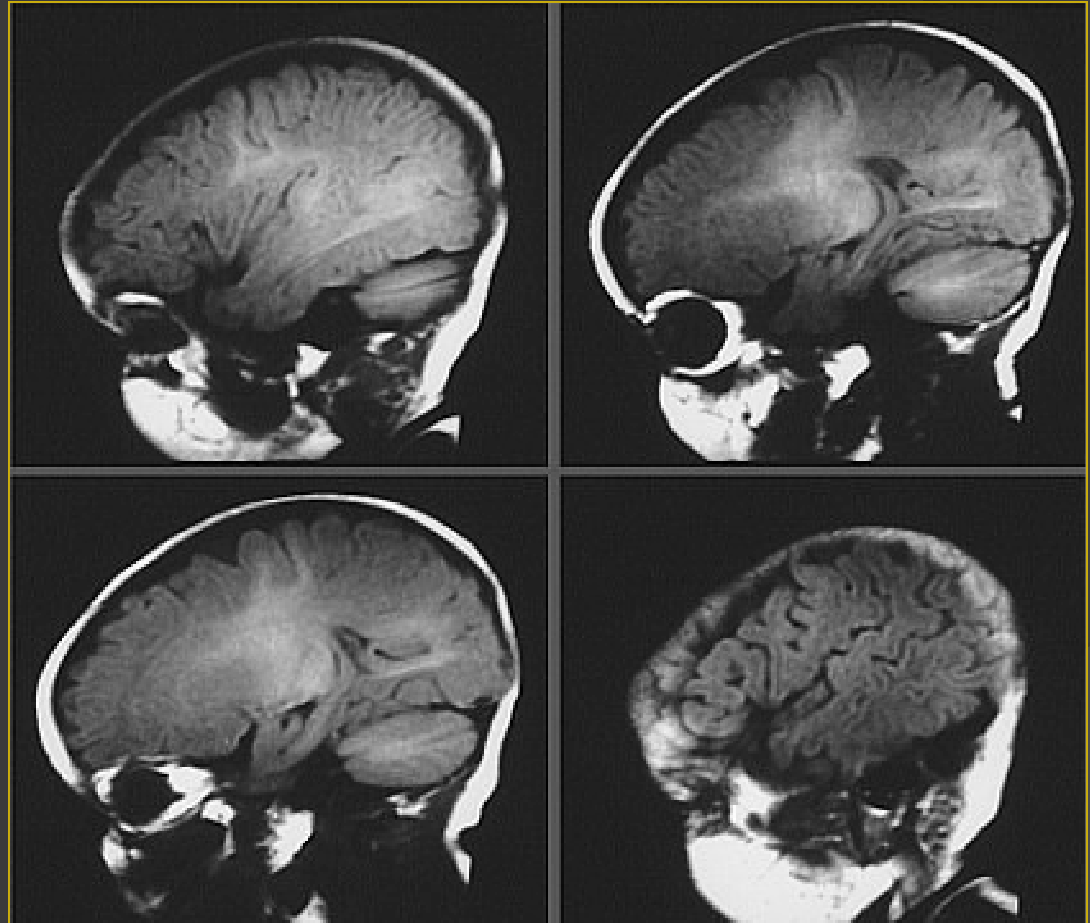
AT BIRTH

- Dorsal brainstem
- Inferior Cerebellar Peduncle /Superior Cerebellar Peduncle
- Periolandic region
- Central portion of centrum semiovale
- Posterior limb of internal capsule to cerebral peduncle
- Ventrolateral thalamus
- Optic nerve, chiasm, tract
- MLF, LL, ML



FIRST MONTH AFTER BIRTH

- Myelin becomes visible in the rest of the basal ganglia and advances in the direction of the postcentral and precentral gyrus



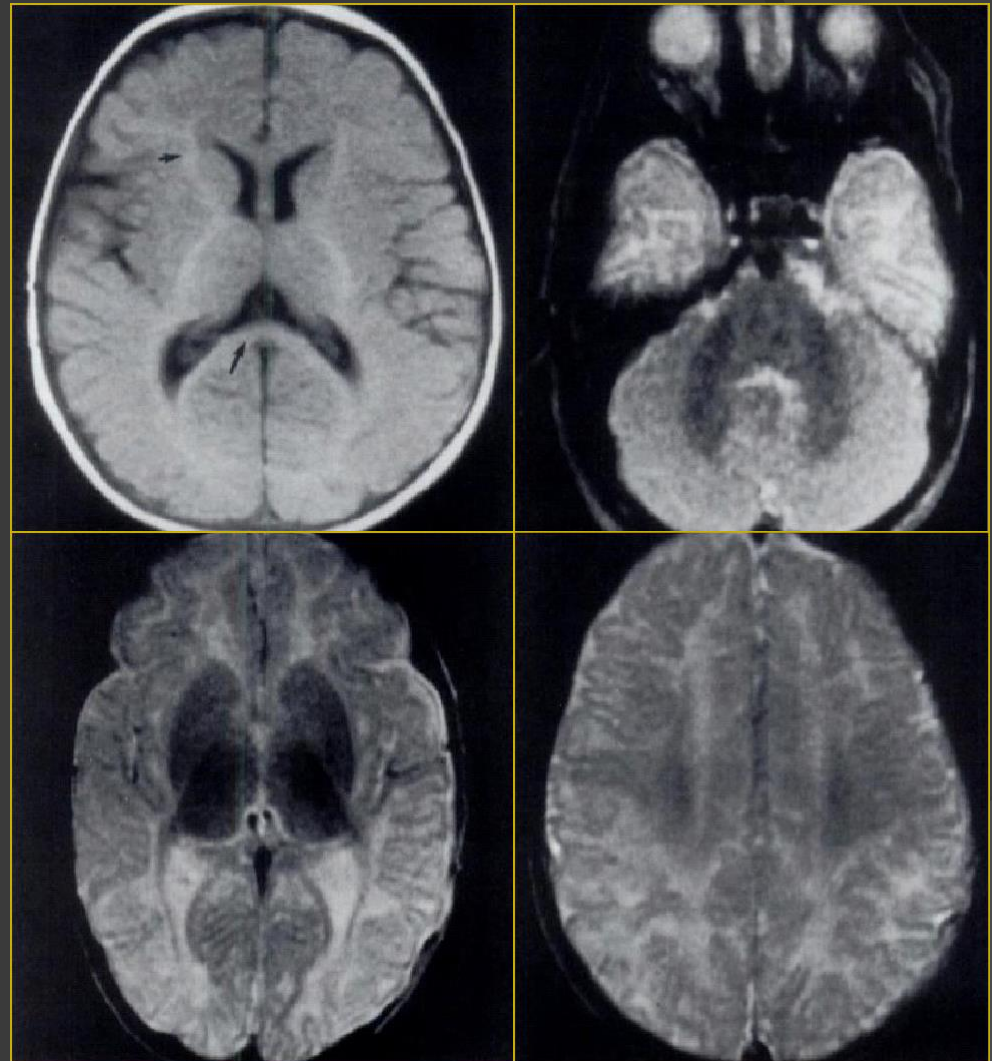
2-3 MONTHS OF AGE

- Optic radiations extends towards the calcarine cortex by 4 months of age
- Begins in Middle Cerebellar Peduncle by 3 months of age



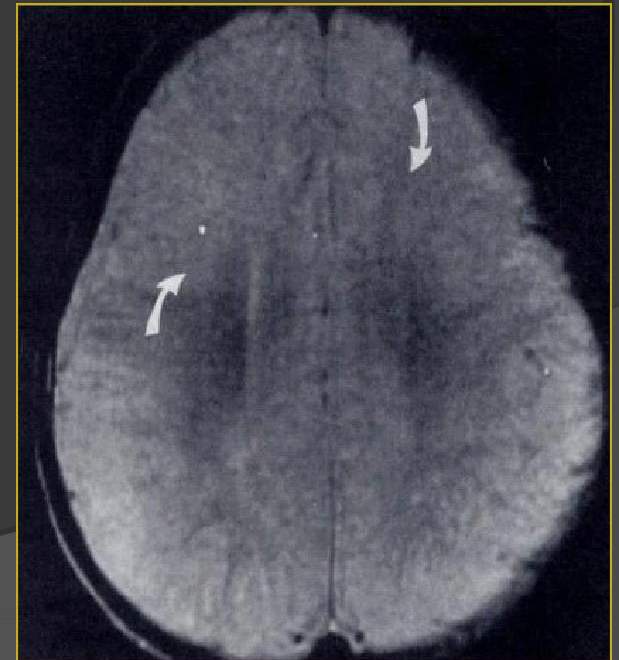
5 MONTHS OF AGE

- Progresses anteriorly in Internal Capsule
- Advances into the centrum semiovale
- Splenium already myelinated
- Pons and MCP becomes more uniform in signal intensity



7 MONTHS OF AGE

- Extends further into the occipital white matter, the forceps minor and major and from the centrum semiovale, peripherally into the parietal and frontal WM by 8 months of age and into the WM of temporal lobe by one year

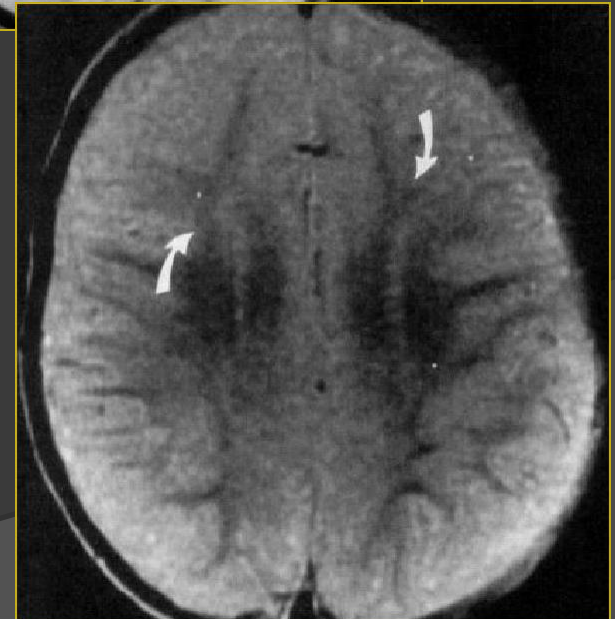
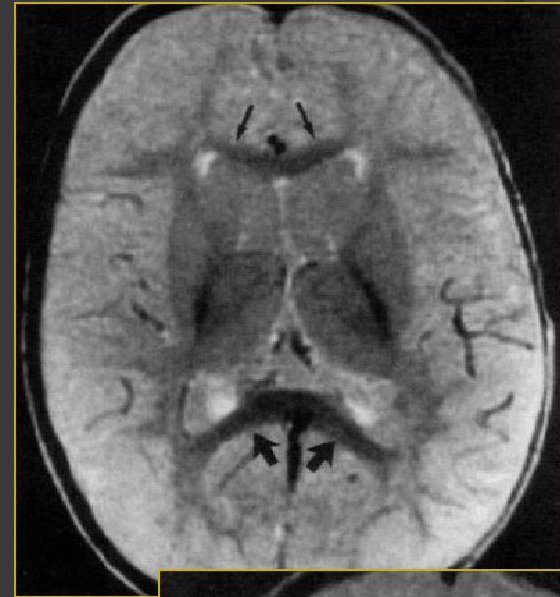


12 MONTHS OF AGE

- Peripheral extension into the subcortical WM begins at about 1 year and is essentially complete by 22-24 months except in the “terminal zones”

- SUBCORTICAL WM

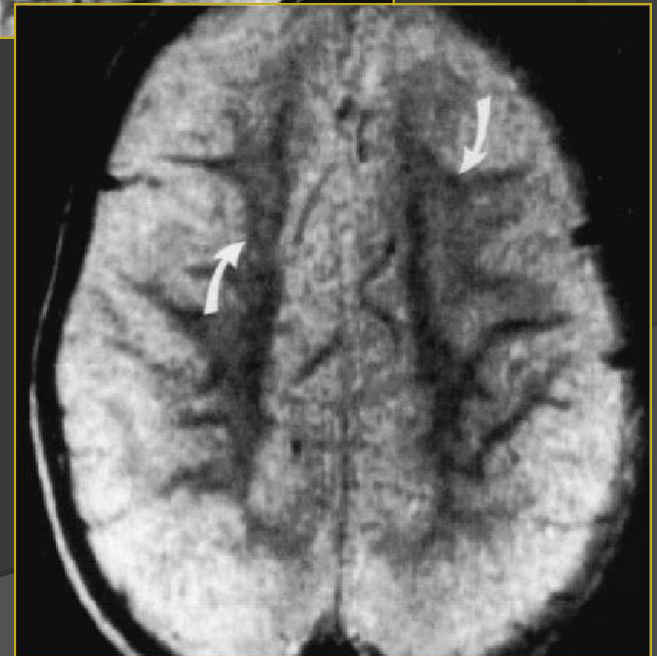
occipital lobe	◇	frontal lobe	◇	temporal lobe
(9-12 mon)		(11-14mon)		(last)



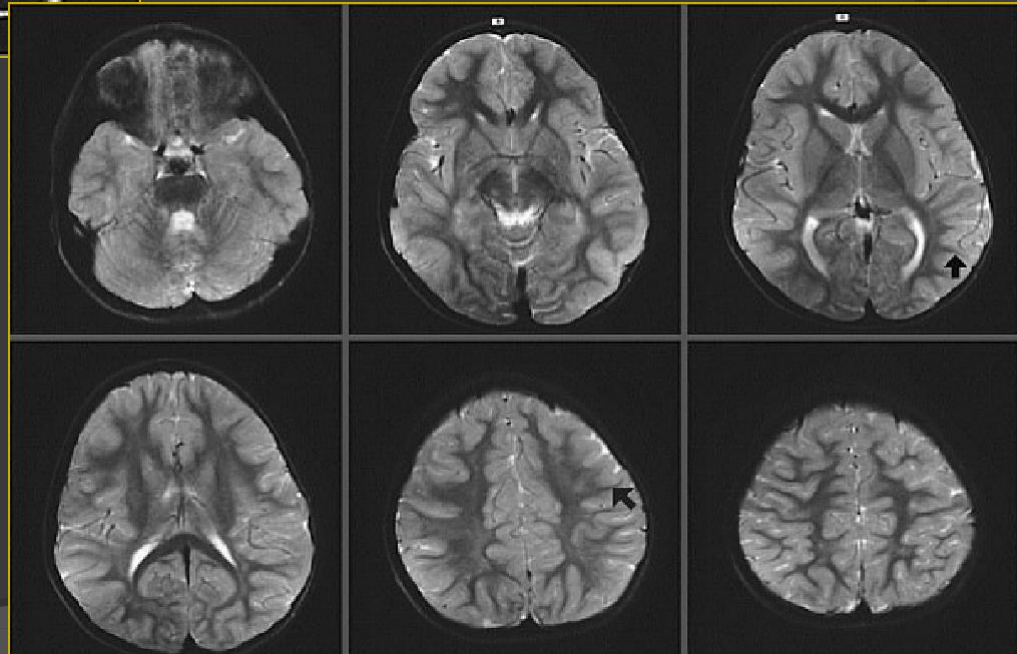
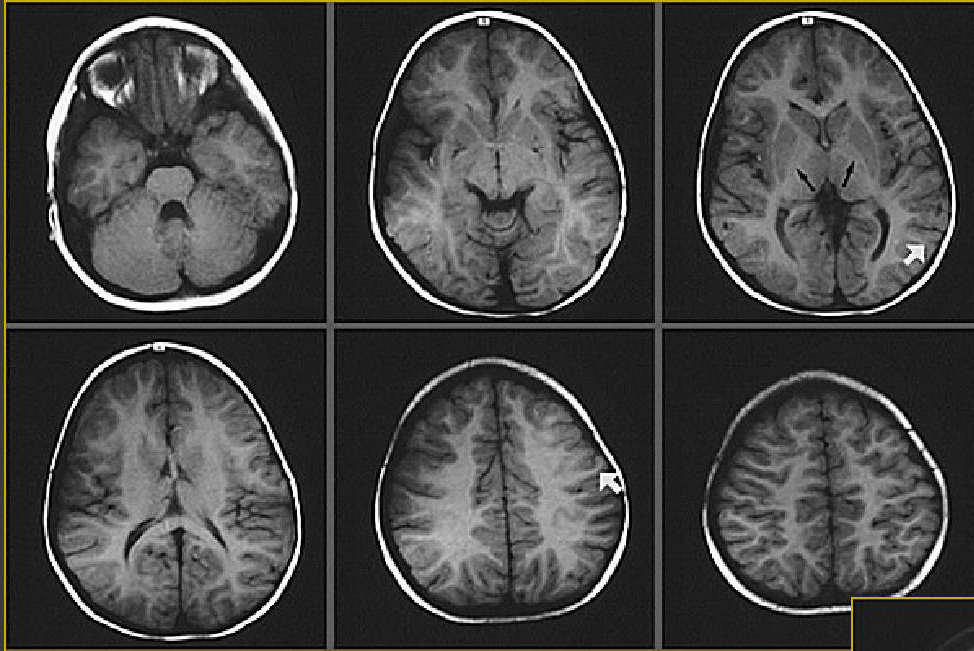
18 MONTHS OF AGE



- Progressive myelination in the IC, CC, forceps minor, forceps major and central and subcortical white matter



24 MONTHS OF AGE



ANATOMIC REGION	T1	T2
Middle cerebellar peduncle	Birth	Birth to 2 mo
Cerebellar WM	Birth – 4 mo	3 – 5 mo
PL of IC – anterior portion	Birth	4 – 7 mo
PL of IC – posterior portion	Birth	Birth to 2 mo
AL of IC	2 – 3 mo	7 – 11 mo
Genu corpus callosum	4 – 6 mo	5 – 8 mo
Splenium corpus callosum	3 – 4 mo	4 – 6 mo
Central occipital WM	3 – 5 mo	9 – 14 mo
Peripheral occipital WM	4 – 7 mo	11 – 15 mo
Central frontal WM	3 – 6 mo	11 – 16 mo
Peripheral frontal WM	7 – 11 mo	14 – 18 mo
Centrum semiovale	2 – 4 mo	7 – 11 mo

Selected Myelination Milestones

AGE	T1 HYPERINTENSITY	T2 HYPOINTENSITY
Birth	Dorsal brainstem Posterior limb IC Perirolandic gyri	Dorsal brainstem Partial posterior limb IC Perirolandic gyri
3-4 months	Ventral brainstem Anterior limb IC CC splenium Central, posterior corona radiata	Posterior limb IC
6 months	Cerebellar WM CC genu Parietal, occipital WM	Ventral brainstem Anterior limb IC CC splenium Occipital WM
12 months	Posterior fossa (= adult) Most of corona radiata Posterior subcortical WM	Most of corona radiata Posterior subcortical WM
18 months	All WM except temporal, frontal U-fibers	All WM except temporal, frontal U-fibers, occipital radiations
24 months	Anterior temporal, frontal U-fibers	Anterior temporal, frontal U-fibers

INHERITED METABOLIC DISORDERS

Lysosomal disorders

- Metachromatic leukodystrophy
- Krabbe's disease
- Mucopolysaccharidoses
- Gangliosidoses

Peroxisomal disorders

- Zellweger syndrome
- Neonatal ALD
- XR adrenoleukodystrophy

Mitochondrial dysfunction

- Leigh disease
- MELAS
- Kearns-Sayre syndrome

Unknown metabolic defect

- Pelizaeus-Merzbacher
- Alexander's disease
- Canavan disease

INHERITED METABOLIC DISORDERS

GRAY MATTER INVOLVED

- ❑ Leigh disease
- ❑ MELAS
- ❑ Glutaric acidurias
- ❑ Propionic acidemia
- ❑ Wilsons disease
- ❑ Juvenile Huntingtons ds
- ❑ PKAN
- ❑ PDH deficiency
- ❑ GAMT deficiency
- ❑ Isovaleric acidemia
- ❑ Urea cycle disorders
- ❑ Mucopolipidosis
- ❑ Glycogen storage diseases

WHITE MATTER INVOLVED

- ❑ Dysmyelinating
- ❑ Demyelinating
- ❑ Hypomyelinating

Inherited metabolic disorders predominantly involving the white matter are divided into

- Dysmyelinating diseases

Defective formation or maintenance of myelin.

- Demyelination disorders

Destruction of normally formed myelin.

- Hypomyelinating disorders

WM partially myelinates but never myelinates completely

APPROACH TO WHITE MATTER DISEASES

1. Are there any useful symptoms?

Head size: Macrocephaly

2 . Is the disorder primarily WM, gray matter or both?

WM : spasticity, hyperreflexia, ataxia

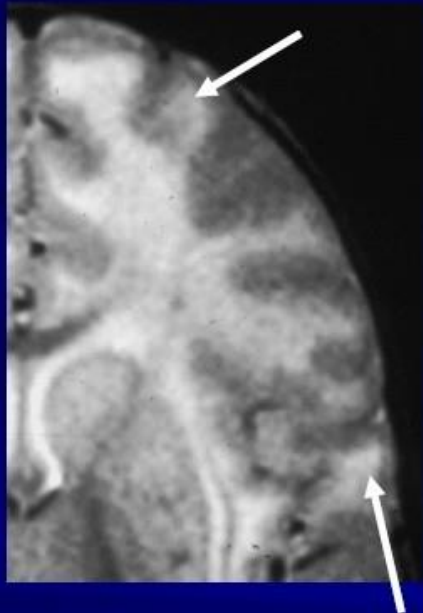
Cortical Grey matter : seizure, dementia

Deep grey matter : athetosis, dystonia, chorea

3. Involvement of Other organs: liver, msk, renal, eye, ear

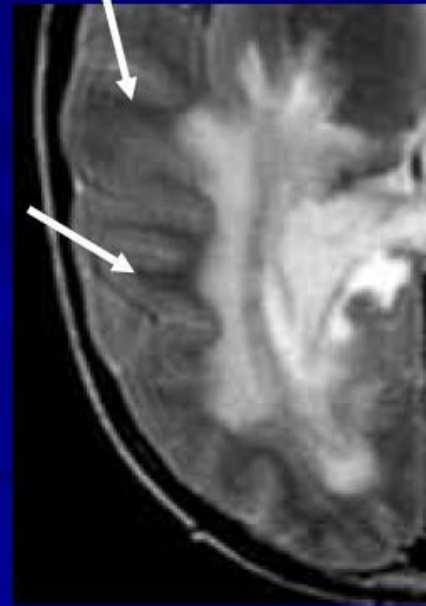
4. Is it primarily SUBCORTICAL or DEEP white matter?

Subcortical vs. Deep?



Note the abnormal signal in the WM extends to the subcortical U fiber region

Note the region of sparing in the subcortical WM region



5. **Distribution** - anterior, posterior, both?
6. Subcortical or deep WM cysts?
7. Thalamic involvement?
8. Brainstem involvement?
9. Delayed or lack of myelination?
10. **CONTRAST**: Leading edge of enhancement?
11. Cortical dysplasia?
12. **MRS** : Elevated NAA, lactate or other peaks

SUBCORTICAL WHITE MATTER DISEASE

With macrocephaly:

Alexander & Canavan
disease

***With macrocephaly +
subcortical cysts***

Van der Knapp disease

***With macrocephaly + ataxia
& decreased myelination***

Vanishing white matter
disease

Without macrocephaly

Galactosemia – also
involves liver

Kearns Sayre – if
globus pallidus is
involved

CANAVANS DISEASE

- Spongy degeneration of the brain (Cannavan Van Bogaert-Bertrand disease)
- AR
- Seen predominantly in Ashkenazi jews
- Defi of N-acetylaspartoacylase
- Accumulation of N- acetylaspartic acid in plasma, urine & brain.
- Preferential involvement of subcortical fibres , peripheral to central.

→ In late cases , brain appears completely demyelinated except IC.

→ There is predominant involvement of occipital lobe.

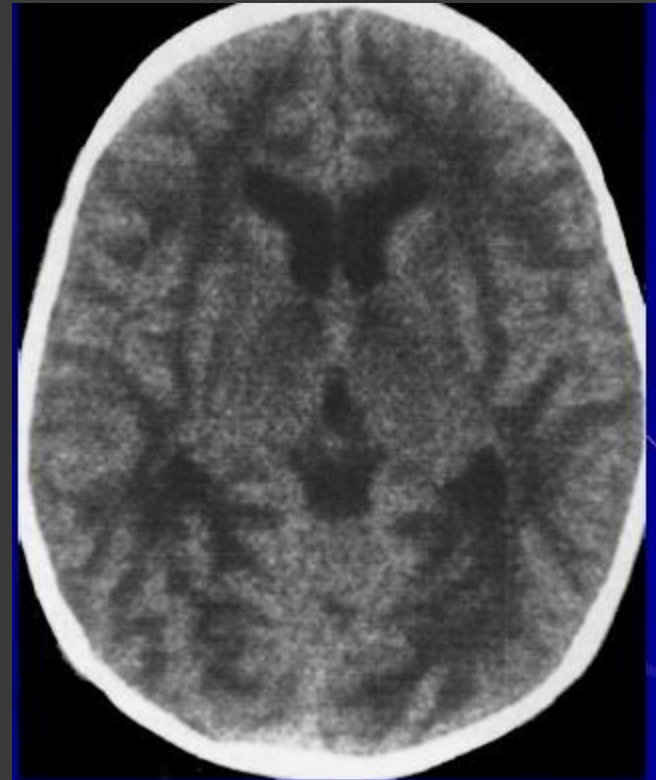
C/F- 2nd to 4th month, hypotonia with head lag in first few weeks of life, followed by macrocephaly & seizures, then spasticity .

→ Death usually occurs before 5 years.

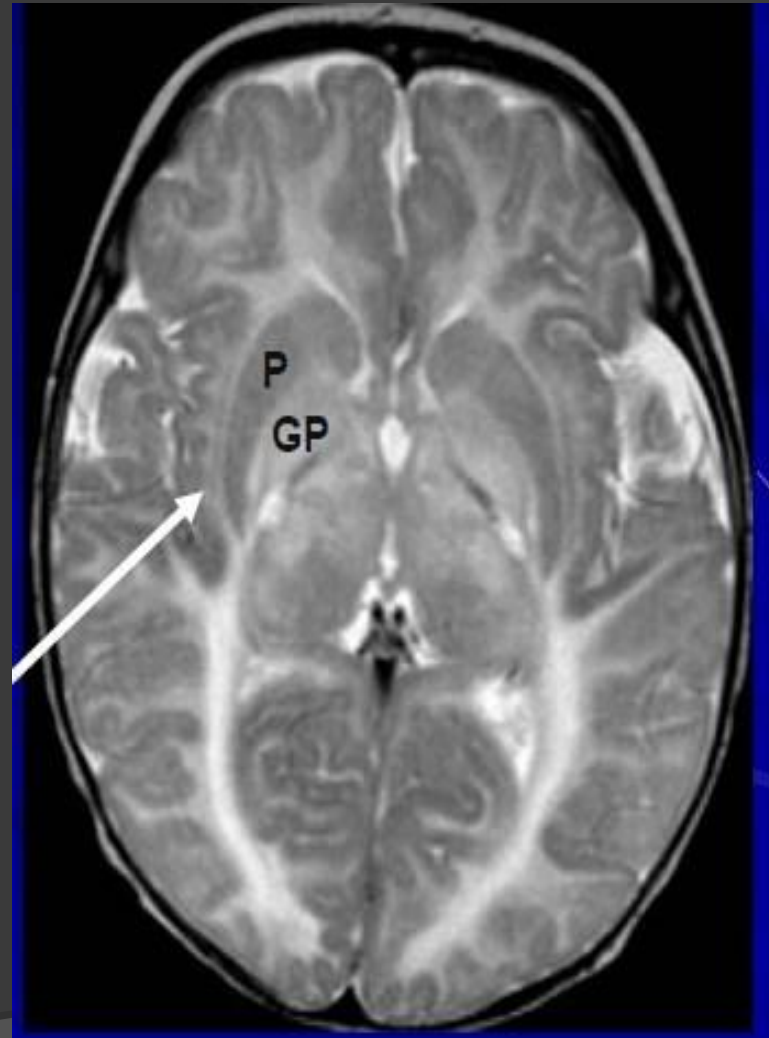
IMAGING

CT

- └ Megalencephaly.
- └ Ventricles are usually normal in size.
- └ Diffuse hypodensity is seen involving
 - Subcortical WM
 - **Globus pallidi**
 - **Thalami**
 - **Extreme capsule**
 - **Claustra**



- MRI
- └ Diffuse white matter hyperintensity is noted on T2W images.
- └ Relative sparing of internal capsule is seen in some cases.
- └ Involvement of GP with normal putamina

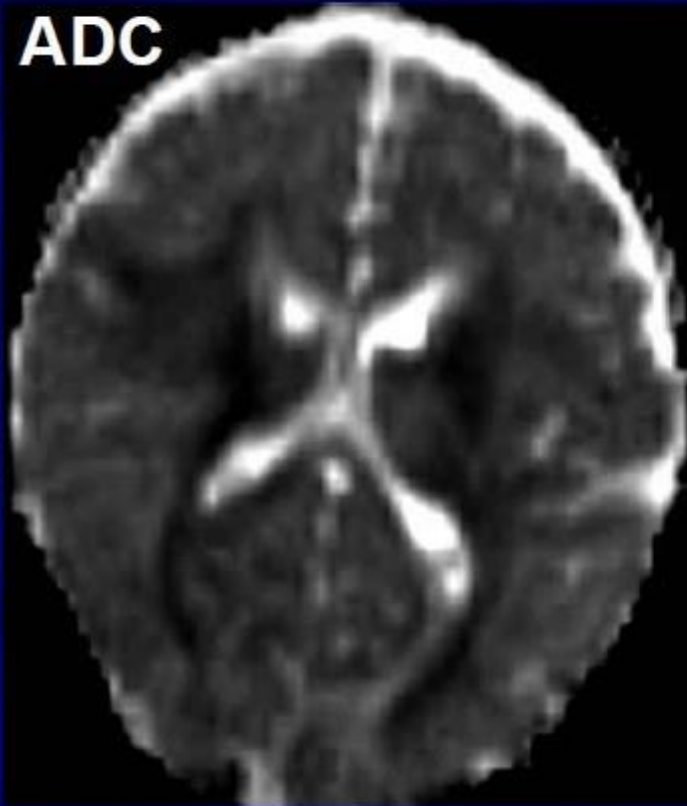


MRI DW IMAGING

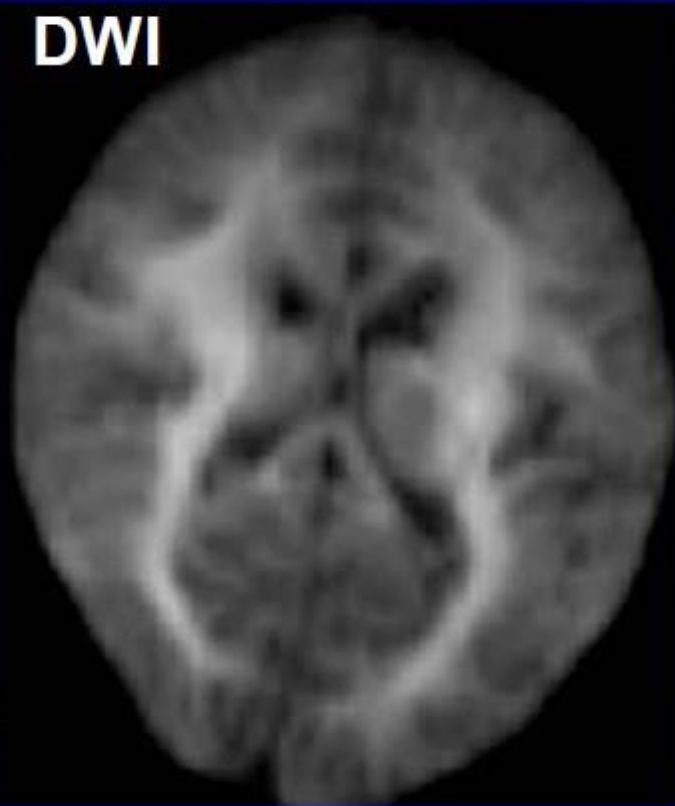
Diffusion restriction only early in the course of disease...later myelin will break down and diffusivity will increase.

■ Restricted diffusion in WM acute disease

ADC

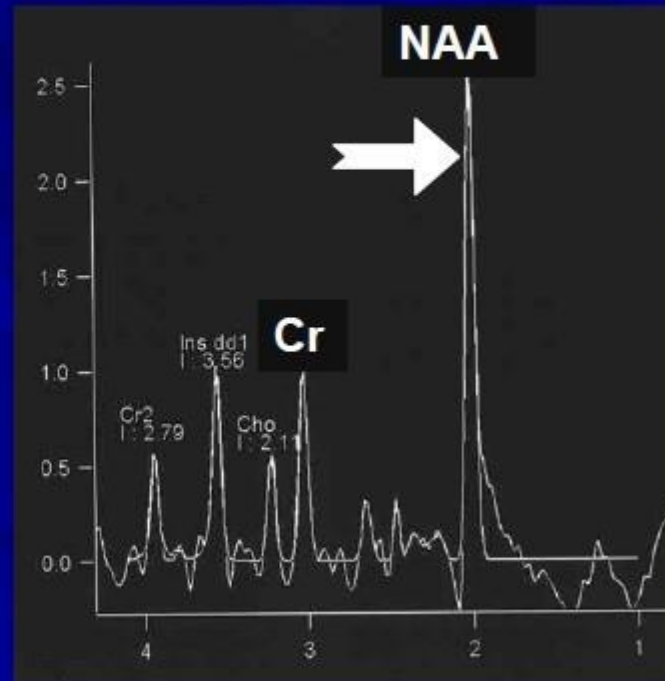
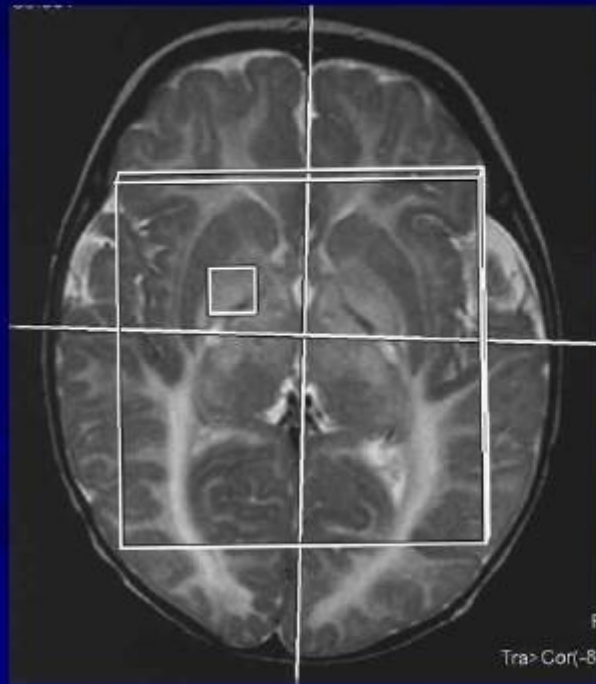


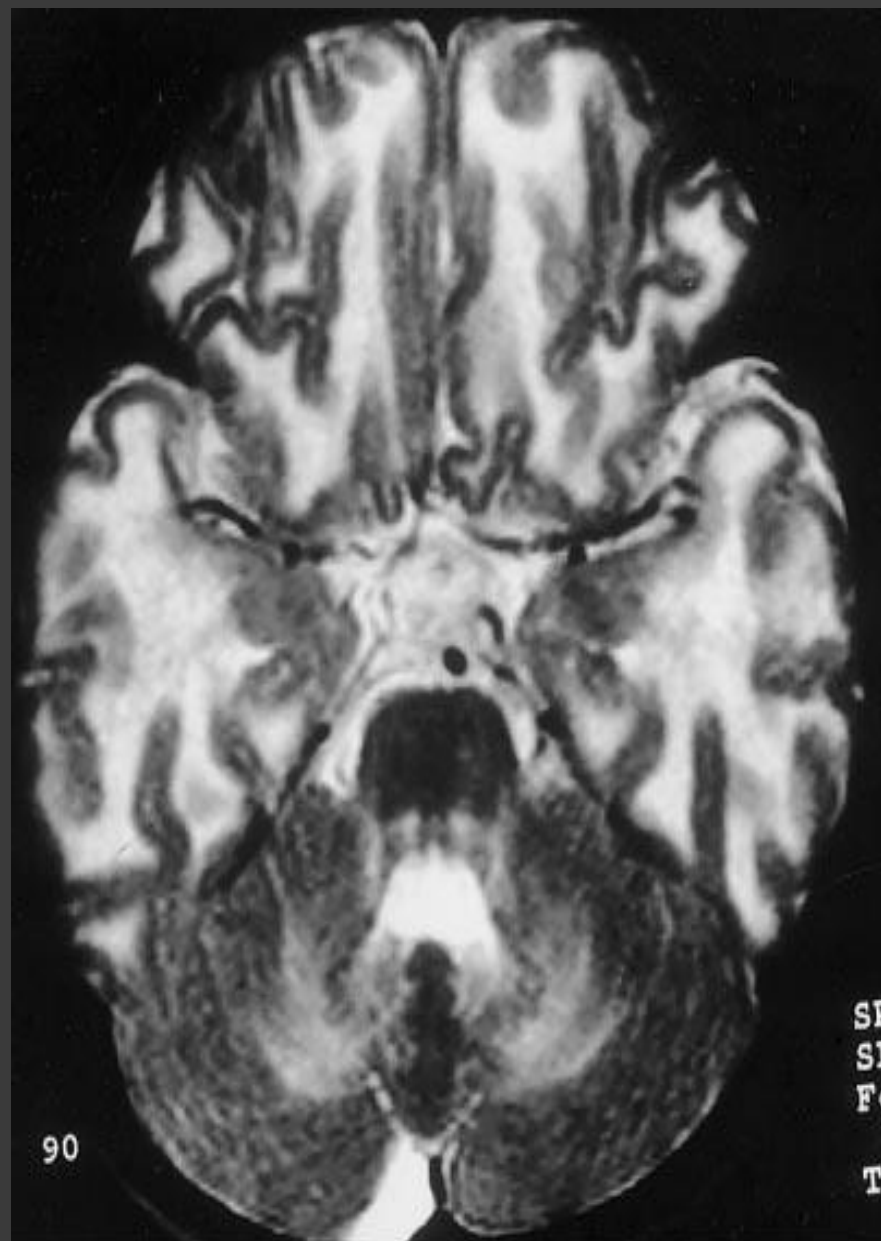
DWI



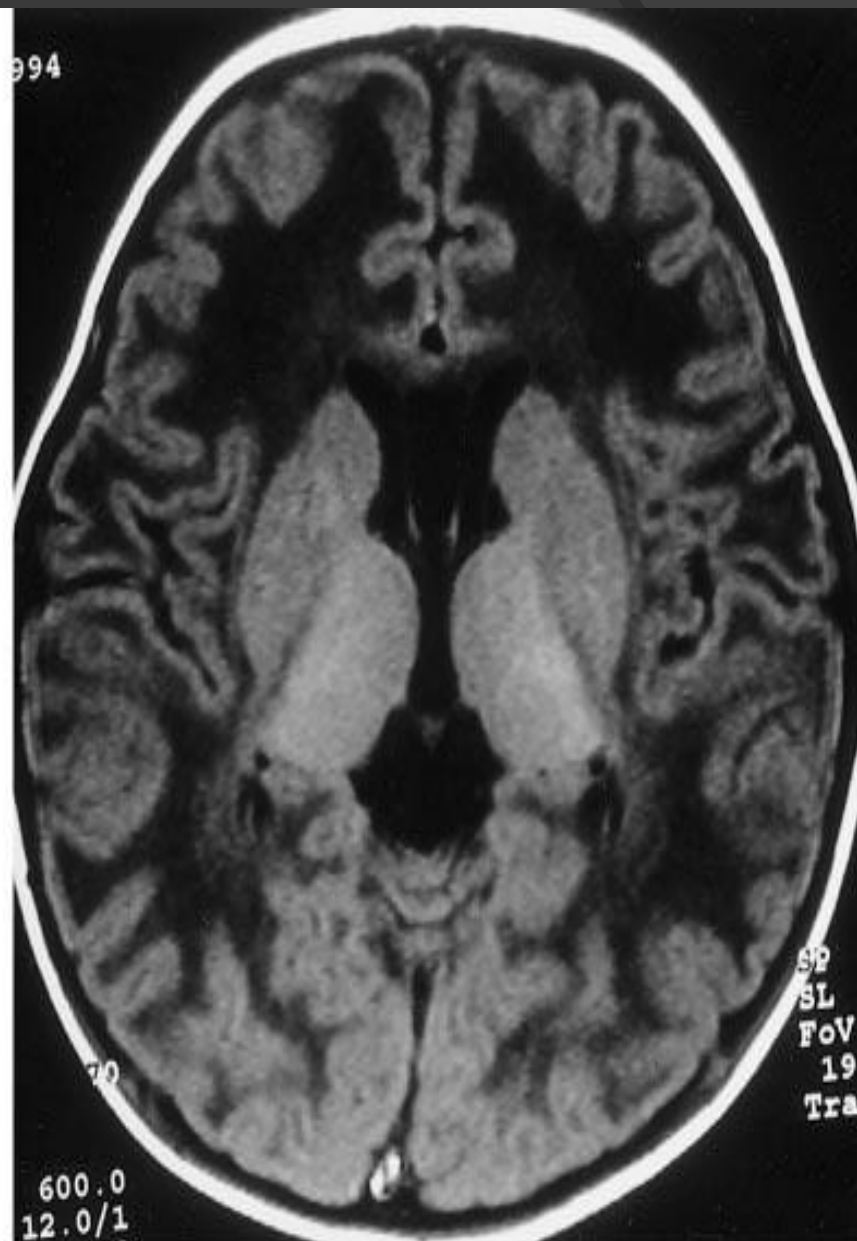
MR SPECTROSCOPY

- **MRS – Marked elevation NAA peak**
- **Specific for Canavan disease**





a.



b.

Canavan's Disease: Pearls

- ❑ Centripetal progression.
- ❑ Relative sparing of Internal Capsule, External Capsule and Corpus Callosum
- ❑ Almost always involves the basal ganglia.
- ❑ MRS-Characteristic NAA peak.

ALEXANDER DISEASE

Sporadic leukoencephalopathy of unknown etiology. Diagnosed by brain biopsy by presence of Rosenthal fibres.

Common involvement – *frontal* lobe PVWM,
thalamus, hypothalamus & BG
-progresses central to peripheral
-Late – involve U fibres

1) Infantile – Macrocephaly, seizures, developmental delay, birth to 2 years

2) Juvenile

Imaging features:

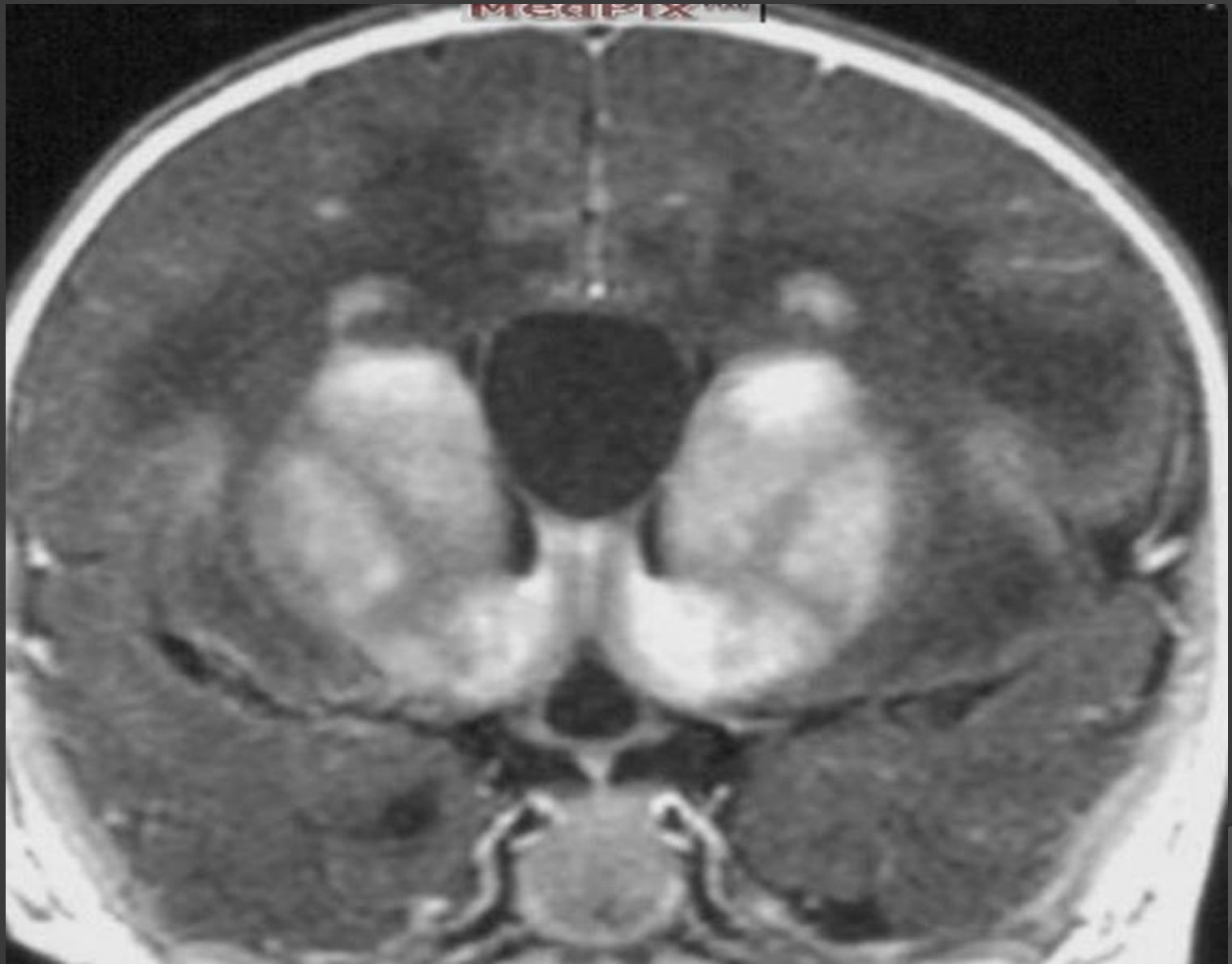
- CT
- └ Macrocephaly.
- └ Hypodensity in bilateral frontal white matter.
- └ Similar hypodensities are also seen in basal ganglia.
- └ On contrast study, enhancement of basal ganglia and periventricular regions are seen.



MRI

- Bilateral frontal lobe hyperintensity on T2W, seen in initial phase of disease is characteristic .
- Enhancement adjacent to frontal horns and caudate heads





MRI IMAGING CRITERIA

ACCORDING TO VANDER KNAPP (AJNR2001)

- ❑ **Subcortical WM, frontal lobe predominance**
- ❑ **Contrast enhancement of gray and WM structures (esp adjacent to frontal horn tips and ventricular trigones)**
- ❑ **Brain stem abnormalities**
- ❑ **Abnormal basal ganglia, thalami**
- ❑ **DWI - increased water motion (bright on ADC map, dark on DWI)**
- ❑ **MRS – low NAA +/- elevated myo-inositol**

Alexander Disease : Pearls

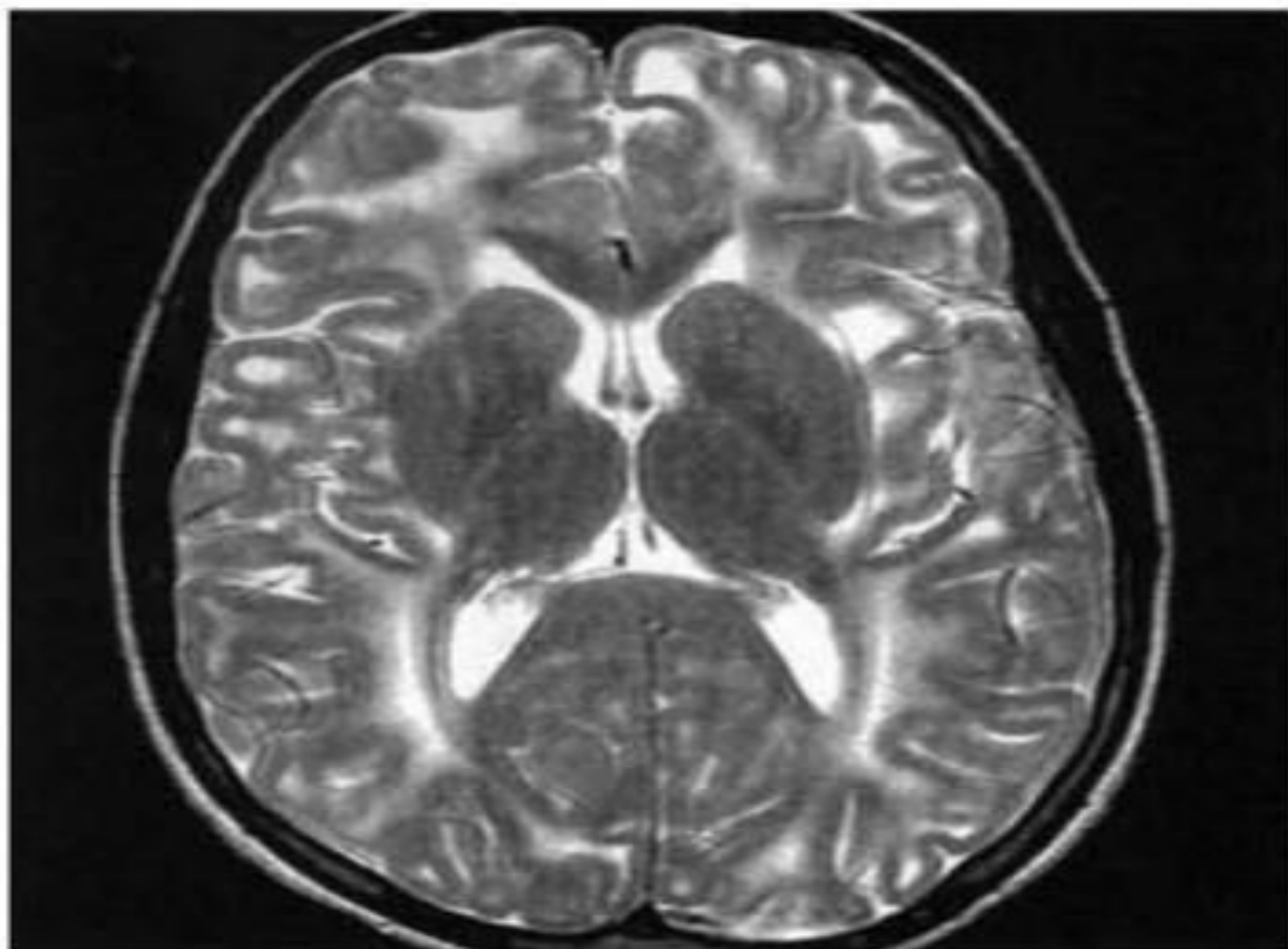
- ❑ Macrocephaly.
- ❑ Frontal lobe predeliction.
- ❑ Progresses posteriorly.
- ❑ Subcortical WM involved early.
- ❑ Late in course cavitation and atrophy seen.
- ❑ CE is a feature.
(near ependymal lining / BG).

MEGALENCEPHALIC LEUCOENCEPHALOPATHY WITH CYSTS

- a.k.a infantile onset spongiform leucoencephalopathy
- Vander knapp syndrome
- AR

- MLC IS DISTINGUISHED FROM OTHER LEUKOENCEPHALOPATHIES BY ITS REMARKABLY SLOW COURSE OF NEUROLOGIC DETERIORATION. INFANTILE ONSET MACROCEPHALY IS EVIDENT BUT NEUROLOGIC DYSFUNCTION IS OFTEN DELAYED !!!!

- ❑ Absent myelin in subcortical WM
- ❑ Diffuse confluent T2/FLAIR hyperintensity involving subcortical WM
- ❑ Affected gyri appear watery and swollen
- ❑ Subcortical cysts in anterior temporal lobe followed by frontoparietal lobes
- ❑ Gray matter normal.
- ❑ Basal ganglia spared
- ❑ CC, IC and cerebellum are usually normal.
- ❑ DWI – increased diffusion (dark on DWI, bright on ADC map)
- ❑ MRS – non-specific; low NAA levels

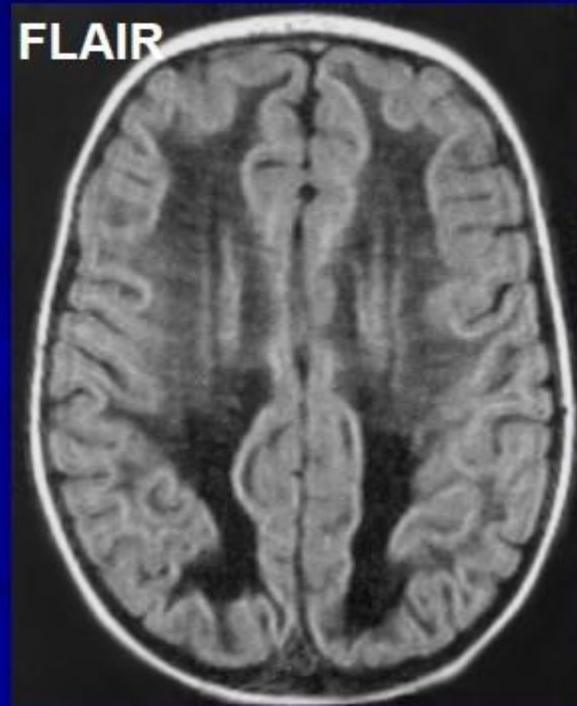
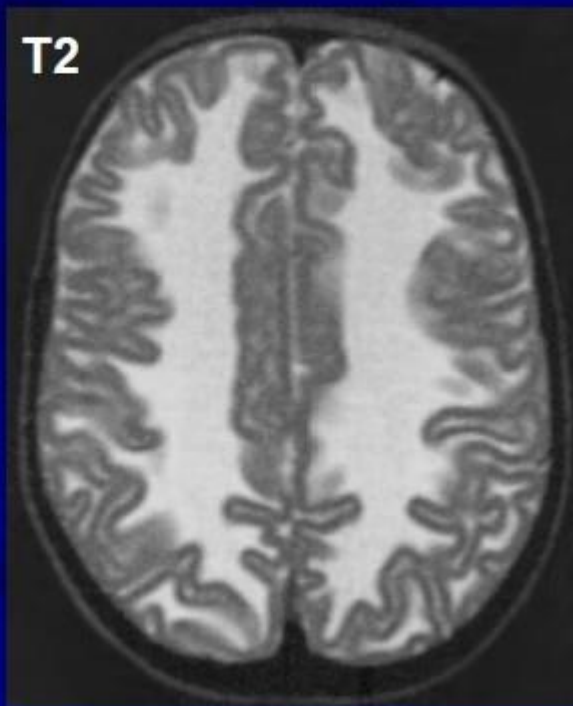


Axial T2WI MR in megalencephalic leukoencephalopathy with cysts shows normal internal capsule and genu myelin maturation, but the remainder including U-fibers are abnormal

VANISHING WHITE MATTER DISEASE

- ❑ **Familial childhood ataxia with diffuse CNS hypomyelination**
- ❑ **Chromosome 3**
- ❑ **Presentation: Relapsing-remitting periods of progressive ataxia & spastic diplegia**
- ❑ **Dx criteria: initial motor and mental (a) development is nl, (b) chronic episodic neuro deterioration, (c) cerebellar ataxia & spasticity (d) MRI shows symmetric WM signal of CSF**
- ❑ **Lab screening: elevated glycine in the CSF, serum and urine**
- ❑ **Prognosis: death 2nd decade**

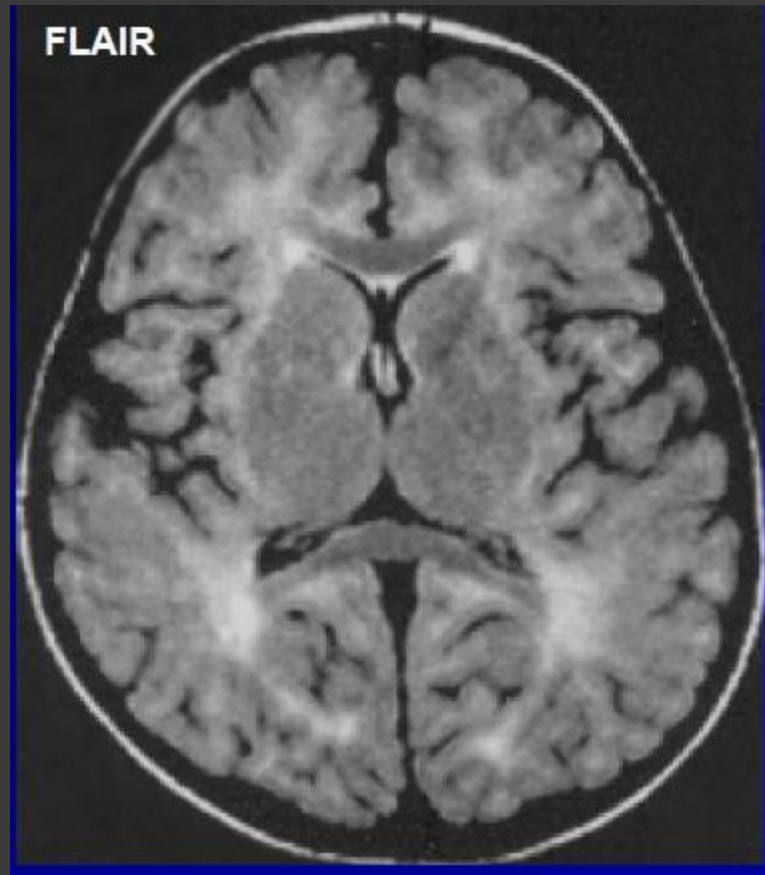
- **WM gradually looks the same as CSF**



GALACTOSEMIA

- Autosomal recessive
- Defective metabolism of galactose due to deficiency of Galactose-1-phosphate-uridyl transferase
- Presentation: newborns or young children with signs of increased intracranial pressure and vomiting
- Untreated: severe liver disease & mental retardation, seizures, choreoathetosis
- Rx: dietary restriction of galactose
- Prognosis: varies

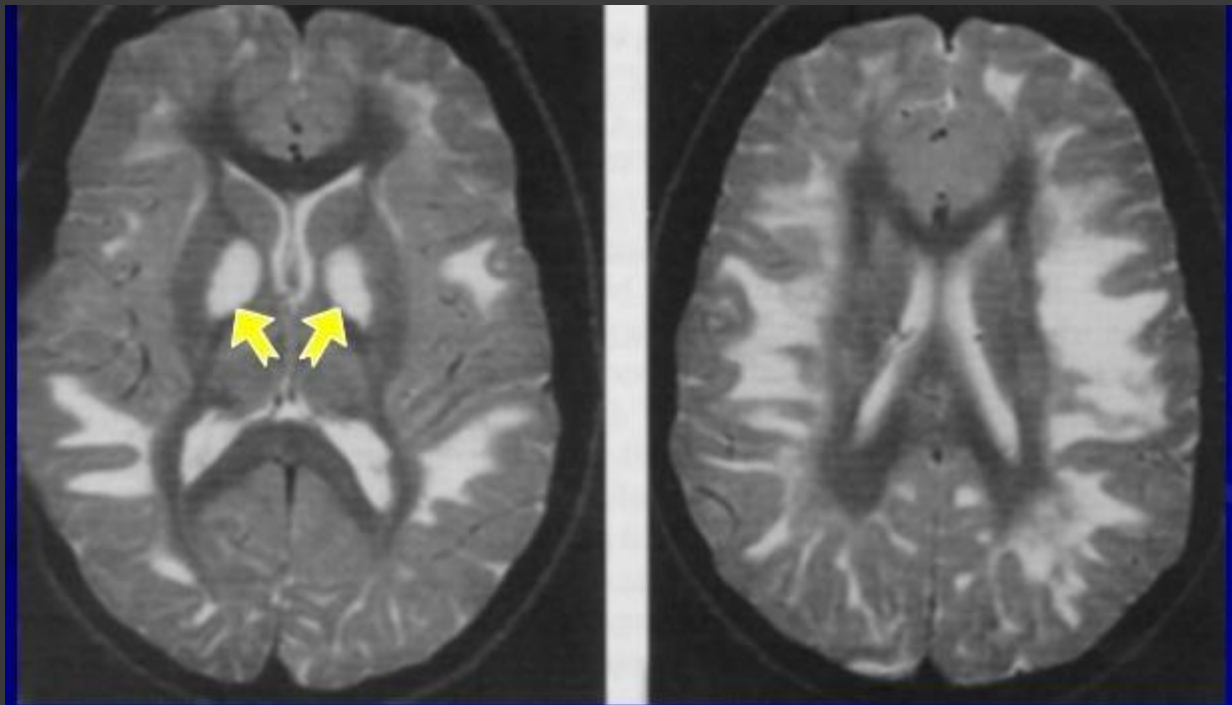
- CT – nonspecific low density WM
- MRI – delayed subcortical WM myelination on T2 (nl on T1);
- Occasional WM focal lesions and late atrophy
- MRS - normal



KEARNS SAYRE SYNDROME

- ❑ Mitochondrial disorder
- ❑ Dx requires external ophthalmoplegia, retinitis pigmentosa and onset of neurologic dysfunction < 20 years +/- protein in CSF, heart block & cerebellar ataxia
- ❑ Imaging: abnormal WM early, atrophy, later basal deep gray matter
 - ❑ CT - WM hypodense with calcifications
 - ❑ MRI -subcortical WM, globus pallidus
 - ❑ DWI - restricted diffusion
 - ❑ MRS – non-specific increased lactate & low NAA

SUBCORTICAL WM AND GLOBUS PALLIDUS INVOLVED WITH SPARING OF DEEP WM



DEEP WHITE MATTER DISEASE

THALAMIC involvement?:

- Krabbe disease
- GM 1
- GM 2

Tay-Sach disease

Sandhoff disease

DEEP WHITE MATTER DISEASE

No *THALAMIC* involvement:

Is there *brainstem* (corticospinal tract) involvement?:

- **X-linked adrenoleukodystrophy** if pons and medulla
- **Maple syrup urine disease** if internal capsule, cerebral peduncle and dorsal pons

If there is no *brainstem (corticospinal tract)* involvement?

- ❑ Metachromatic leukodystrophy
- ❑ Phenylketonuria
- ❑ Mucopolysaccharidoses
- ❑ Lowe disease
- ❑ Merosin deficient muscular dystrophy

KRABBE'S DISEASE (GLOBOID CELL LEUKODYSTROPHY)

- Autosomal recessive
- Deficient enzyme; galactocerebroside beta galactosidase, accumulation of psychosine toxic to oligodendrocytes.
- Infantile, late infantile and adult forms.

Presentation: 3-6 months, hypertonia, irritability, fever, developmental delay, poor feeding, optic atrophy, opsomyoclonus & Hyperacusis

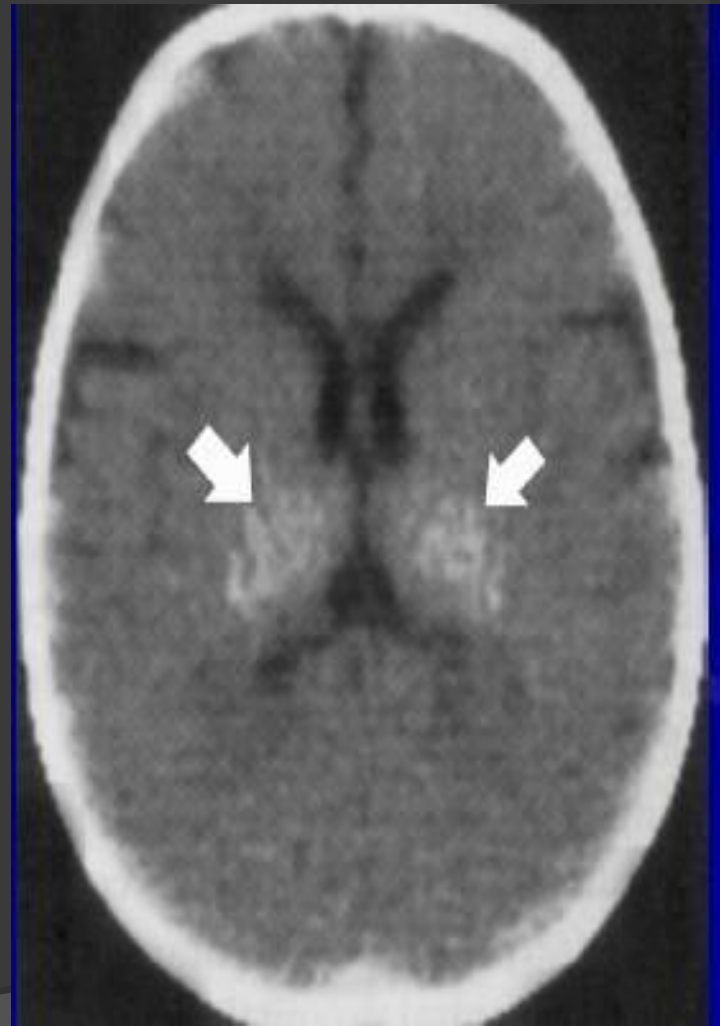
Location : Periventricular white matter and centrum semiovale.

- ♣ Subcortical U fibres are typically spared.
- ♣ Parietoccipital lobes are involved early.
- ♣ Optic nerve hypertrophy may be seen.
- ♣ AUDITORY PATHWAY INVOLVEMENT IN ALD

IMAGING

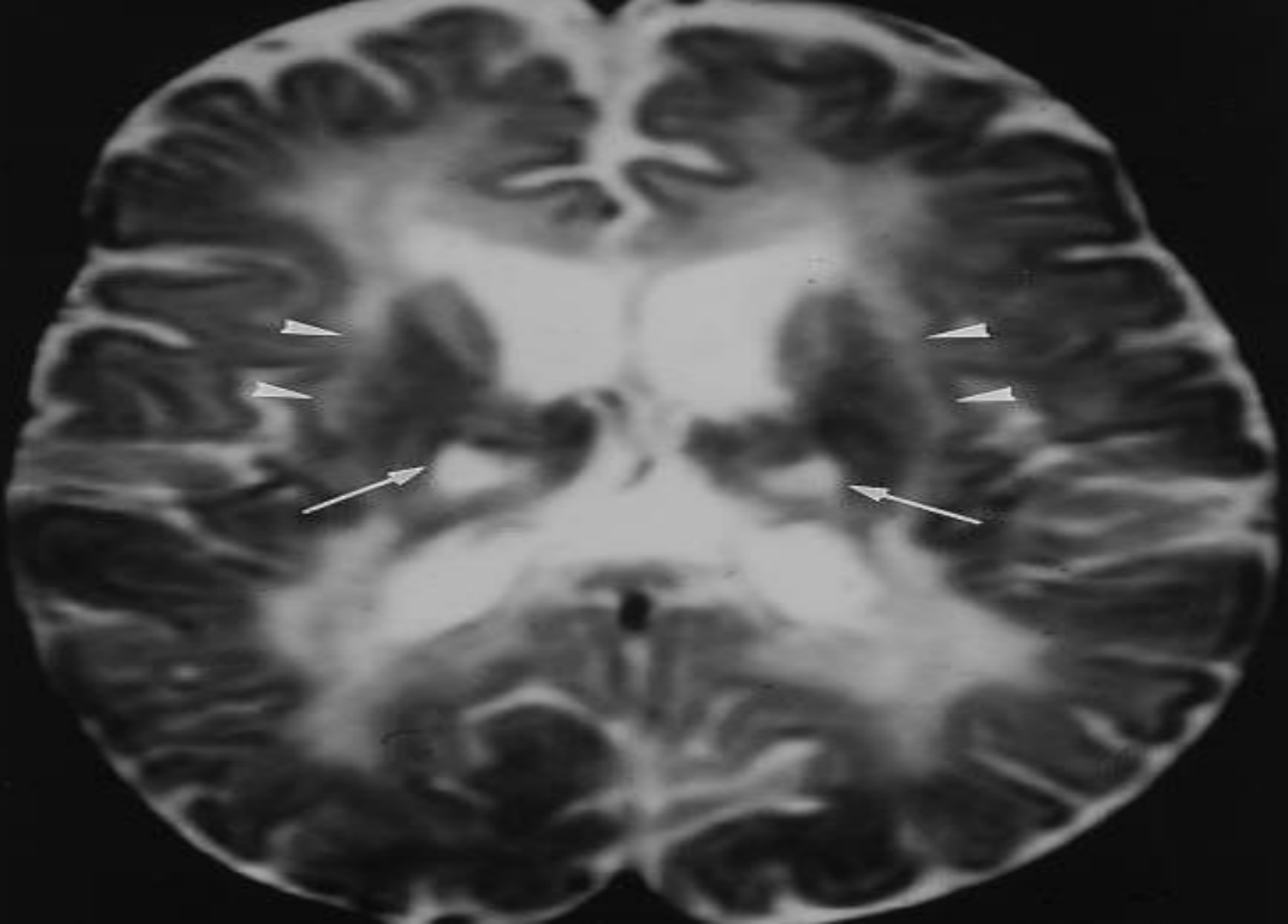
□ CT

- Thalami and basal ganglia appear hyperdense in very early stage when MRI is negative.
- Hypodense lesions are seen in periventricular white matter.
- No enhancement on post contrast study.



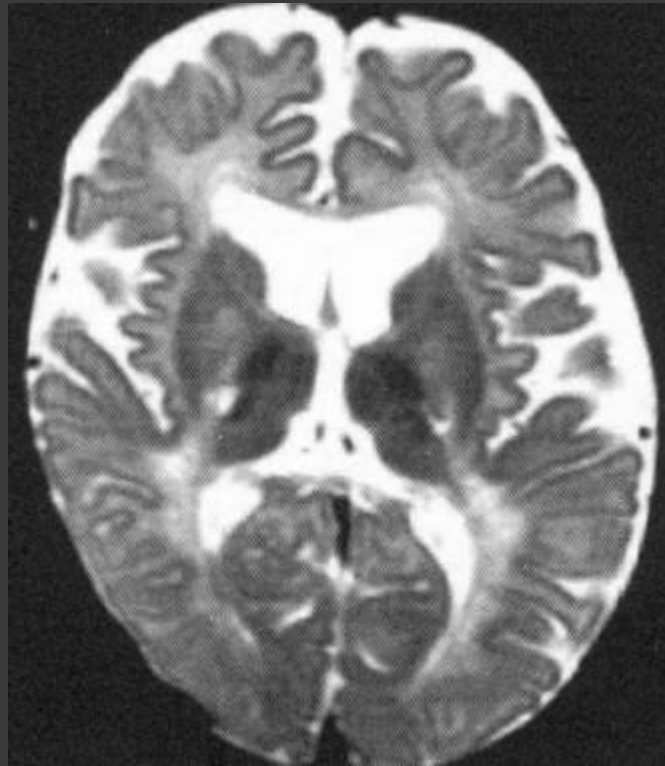
MRI

- Confluent symmetrical periventricular and corticospinal tract hyperintensity on T2W and FLAIR images.
- Bithalamic hypointensity on T2WI.
- Early involvement of cerebellum (diff from MLD).
- Severe progressive atrophy.
- Diffuse hyper signal in spinal cord, CE of nerve roots
- No enhancement

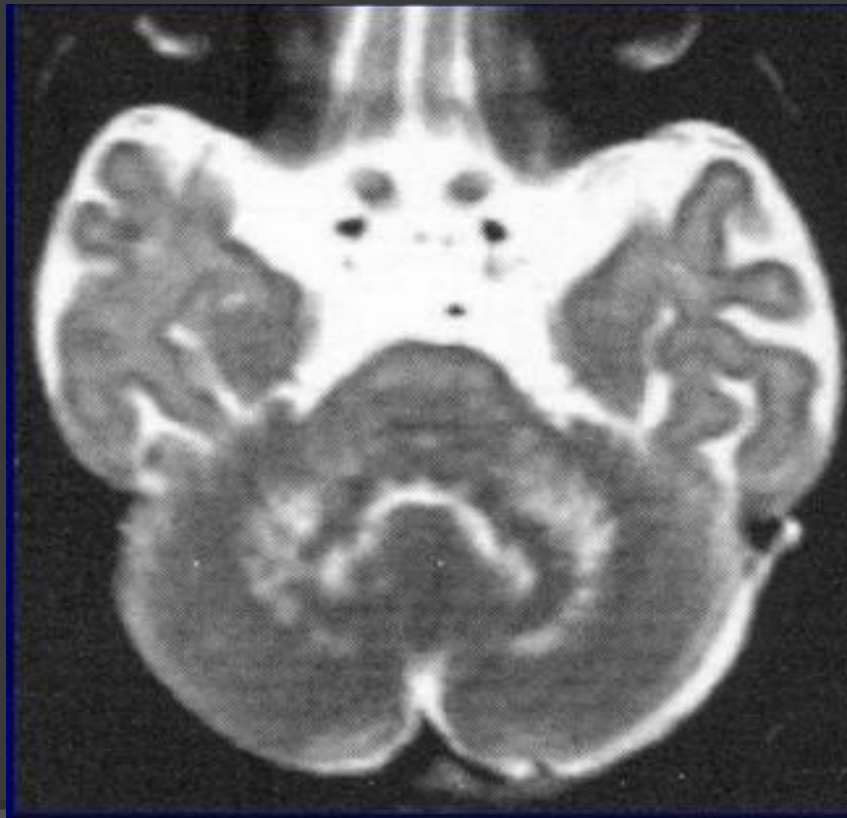


Krabbe disease in a 2-year-old boy. T2-weighted MR image demonstrates symmetric high-signal-intensity areas in the deep white matter. The internal and external capsules are also involved (arrowheads). Note the bilateral areas of abnormal signal intensity in the thalami (arrows).

T2 HYPOINTENSE THALAMI



Cerebellar findings appear early in the course of disease. Alternating 'halo' or ring like hypointensities on T1WI and hyperintensities on T2WI can be identified in the cerebellar WM surrounding the dentate nuclei.



Krabbe's Disease : Pearls

- Cortico spinal tract early involvement
- Cerebellum early involvement.
- Hyperdense thalami ,caudate nuclei and corona radiata (characteristic but not specific)...corresponding to fine calcification.

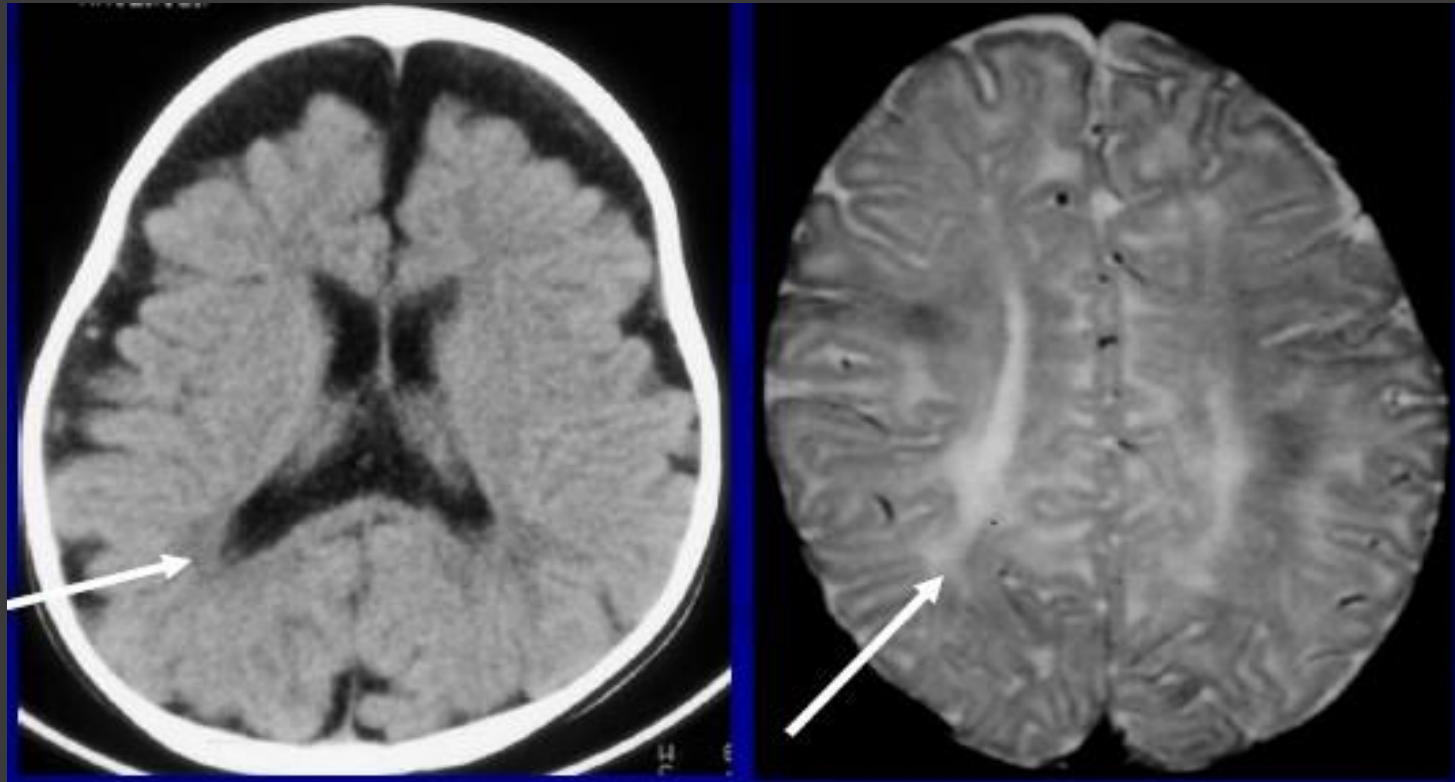
GM1 GANGLIOSIDOSIS

- ❑ Rare lysosomal disorder
- ❑ Deficient activity of beta-galactosidase
- ❑ Chromosome 3
- ❑ Three forms: Infantile, childhood, adult
- ❑ Infantile - most common

Dysmorphic facial features, osseous dysplasias, hepatosplenomegaly, hypotonia, mental retardation early childhood (between 1-5 years),

- ❑ Childhood (1-5 years) seizures, spasticity, Death in a few years
- ❑ Childhood & adult forms – more slowly progressive dysarthria, ataxia, myoclonus, normal facies, no hepatosplenomegaly

CT- Hypodense WM, late atrophy
T2WI : bright WM



GM2 GANGLIOSIDOSIS

- Autosomal recessive sphingolipidosis
- Deficient hexosaminidase (2 parts)

Isoenzyme A – Tay Sachs disease

Isoenzyme A & B – Sandhoff disease

- Accumulation of GM2 ganglioside causes damage
- Clinical & imaging findings are similar for TSD & SD

Presentation:

- Infant with hypotonia, psychomotor retardation
- Late first year - spasticity, weakness, dystonia, ataxia, then macrocephaly, abnormal movements, seizures
- After 3-10 years severe dementia & bed ridden

- **Imaging nearly identical for GM1 & GM2**
- **CT— early hyperdense thalami & hypodense WM, late atrophy**
- **MRI –T2 bright periventricular WM**

Tay-Sacchs: Posteromedial thalami T2 bright with reduced diffusion

Sandoff: Basal ganglia isointense with WM

- **Late stage atrophy cerebral and cerebellar hemispheres**

Dif fuse atrophy, Hypoattenuated WM, Hyperdense atro phic thalami



ADRENOLEUKODYSTROPHY

→ Group of 3 disorders-

1) Adrenoleukodystrophy (X-Linked)

2) Adrenomyeloneuropathy (AMN)

3) Adrenoleukomyeloneuropathy (ALMN).

→ X-ALD- deficiency of acyl CoA synthetase

→ Age- ALD-3-10yrs, AMN- young adult.

Rare neonatal form: AR, multiple enzyme
Deficiencies

Involvement of CNS, Adrenal, Testes

CLASSIC XLINKED ALD

- Boys 5 – 12 years old
- Learning difficulties (ADHD), impaired vision, gait or hearing, abnormal pigmentation skin (adrenal insufficiency), 10% seizures, adrenal crisis, coma
- Progression is rapid
- DDx: None with appropriate history **Acyl**
- **CoA oxidase deficiency – similar**
imaging, but history differs; 2 year old girls & boys, delayed cognitive & motor development

Location- Early peritrigonal WM demyelination across corpus callosum spreads outward & forward to involve WM

Atypical – U/L & frontal lobe

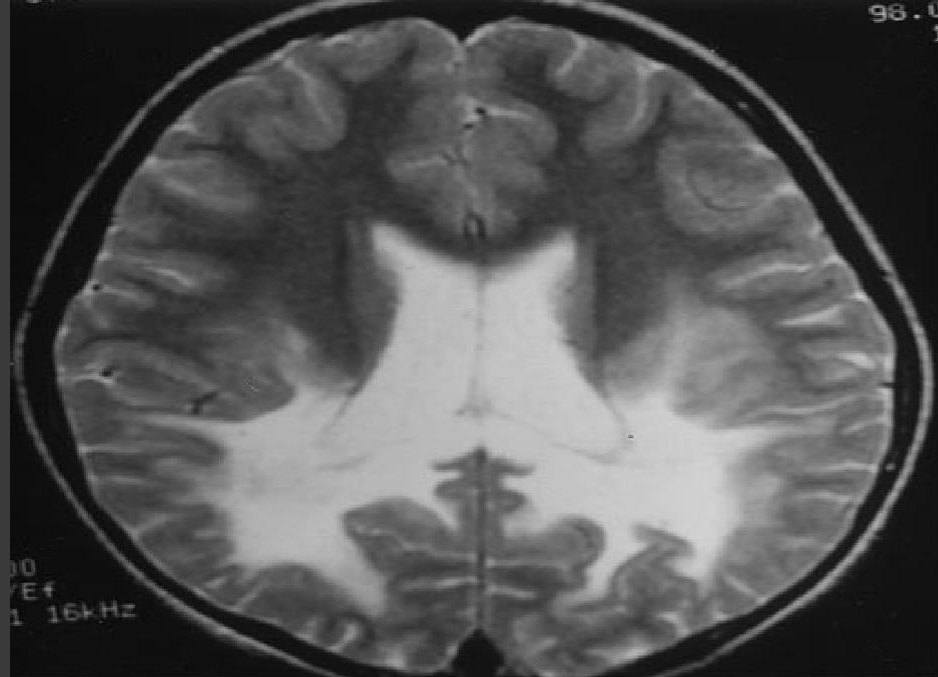
Auditory pathway involvement common.

Microscopic appearance -

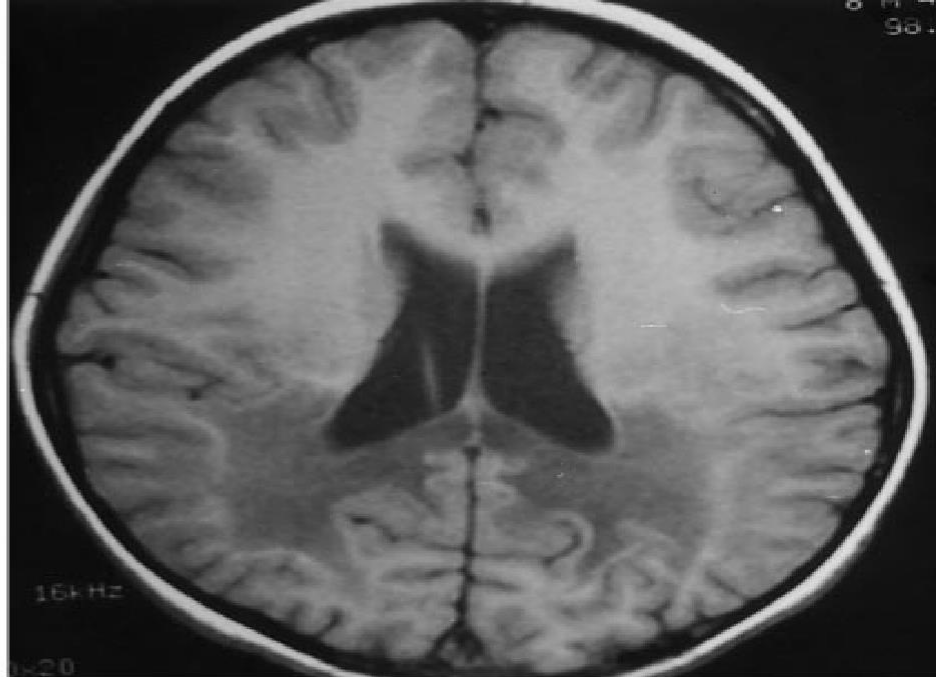
1)Central portion (necrotic)- which show absent myelin sheath and oligodendroglia.

2)Next zone is of active inflammation & demyelination. Enhances after contrast.

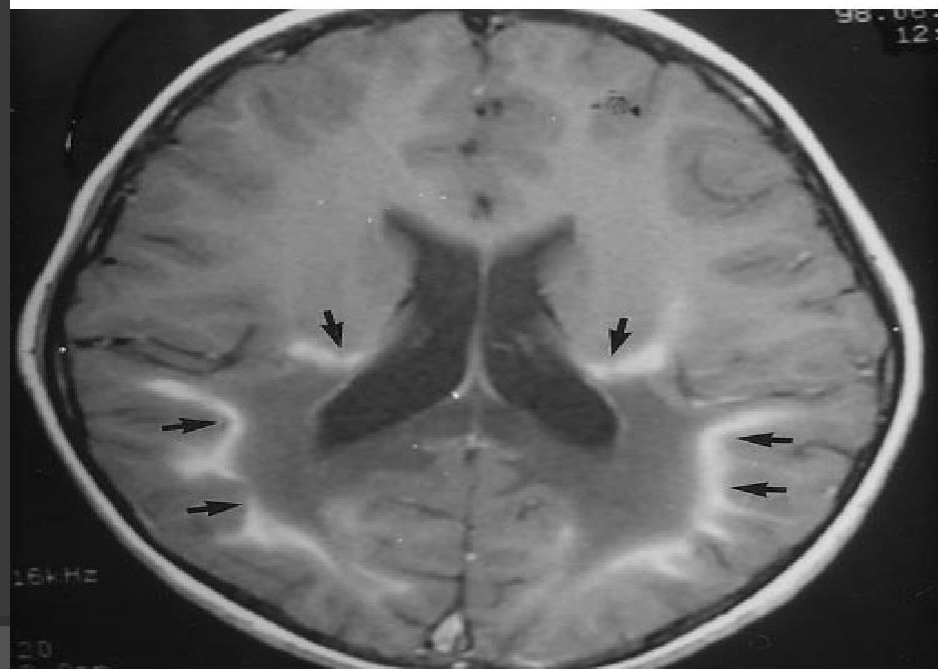
3)Outer zone -shows demyelination but no inflammatory changes.



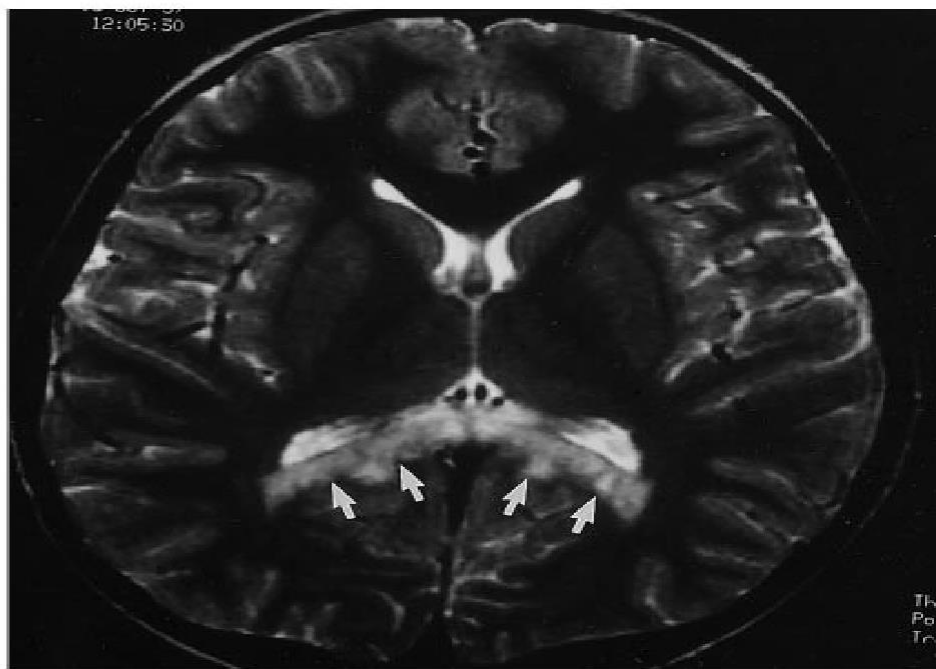
7a.



7b.



7c.



8.

X-linked ALD

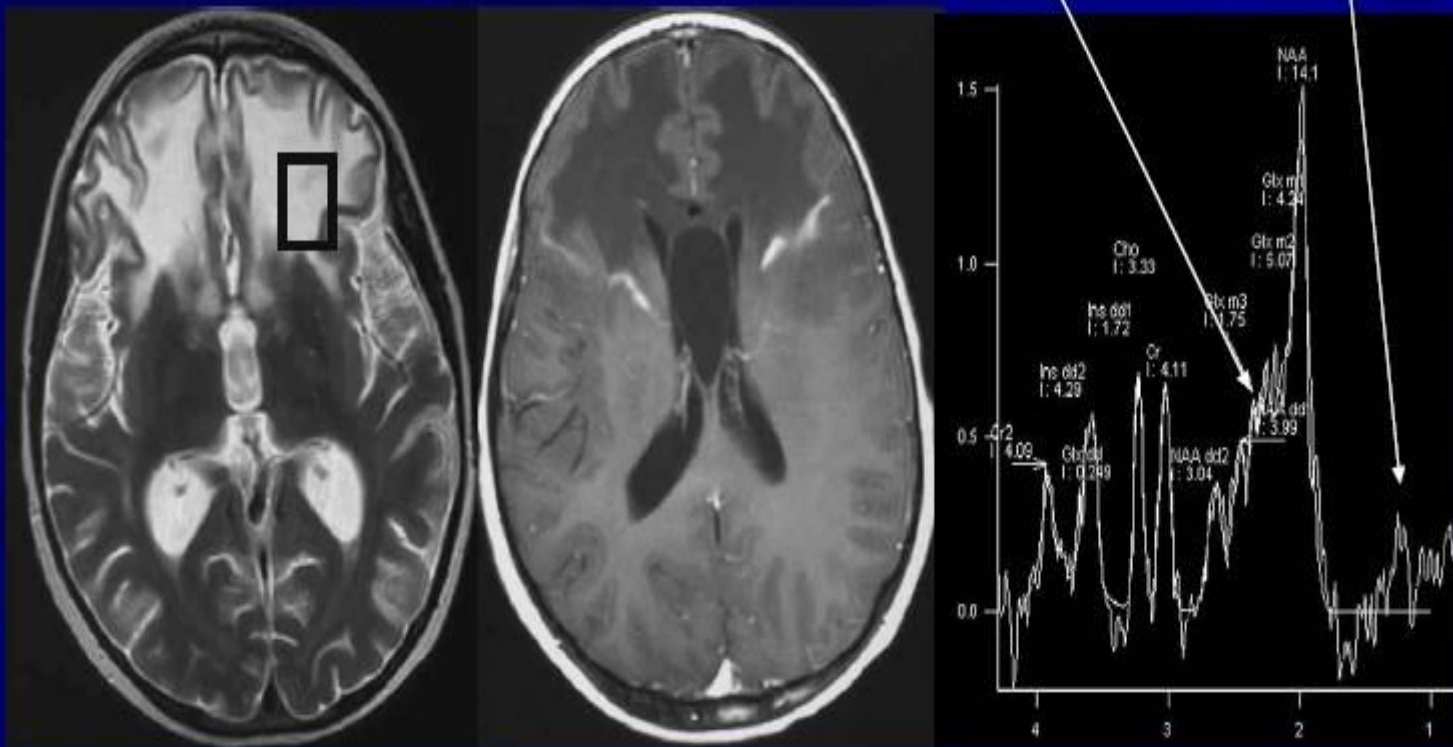
- **Posterior (85%)** distribution is most common

Note 3 zones:

- **Burned out**
- **Inflammatory**
- **Demyelinating**



- Atypical **frontal distribution (15%)**
- MRS – elevated glutamine/glutamate & lactate



- MRS plays an important role as it shows abnormalities before the MR imaging study becomes abnormal in these children.
- In zone C, NAA/choline ratio < 5 is predictive of disease progression within the next 2-3 years. Therefore it should be performed in all patients with ALD so that BM transplantation can be done early in the course of rapidly progressive disease.

ALD: Pearls

- ❑ Centrifugal And postero anterior pattern.
- ❑ Corpus callosum and Cortico spinal tract involvement
- ❑ Pontomedullary corticospinal tract involvement
- ❑ Contrast Enhancement is a feature.

MAPLE SYRUP URINE DISEASE (MSUD)

→AR

→Due to failure to catabolise branched chain aa
leucine, iso-leucine, valine

→Ketoacids accumulate

→Metabolites excreted in urine (characteristic odour)

C/F

- Presents 4 to 7 days after birth.
- Severe rapidly progressive neurologic course .
- Without treatment death occurs in one year.

Imaging

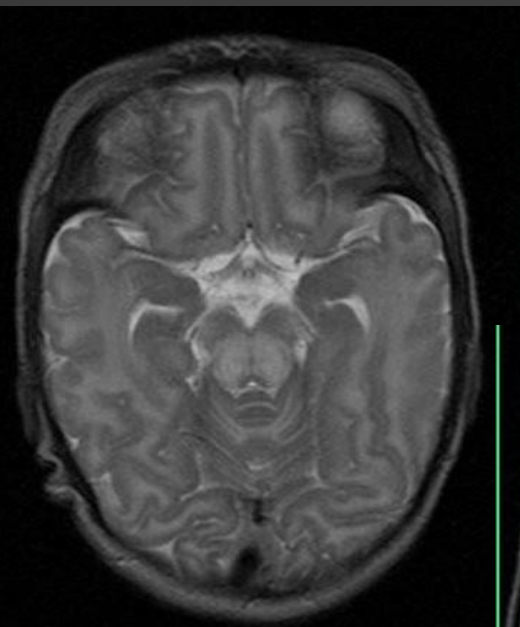
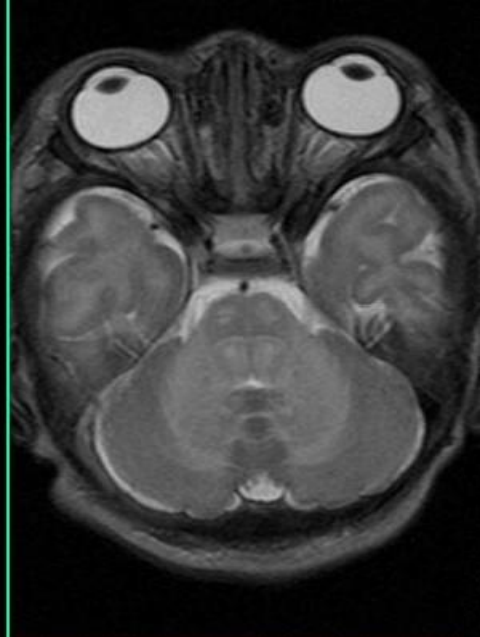
CT

- Initial scans are negative during first few postnatal days.
- Then there is Generalised Cerebral Edema
- Followed by periventricular white matter disease.

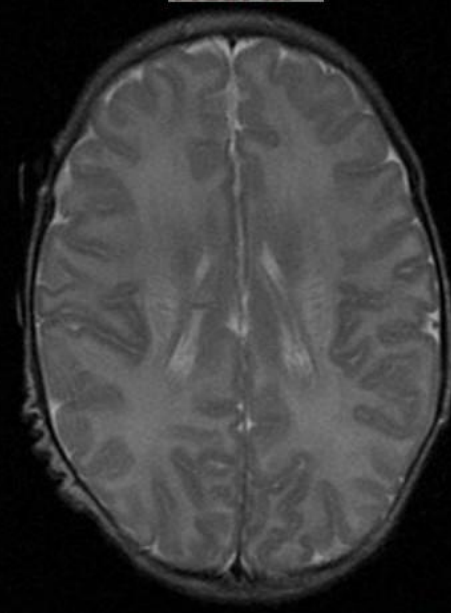
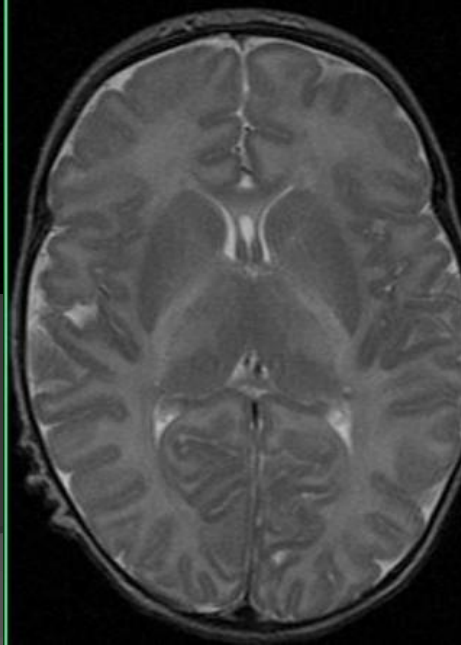
MRI

- T2W images show high signal in these areas.
- Oedema occurs in characteristic location.

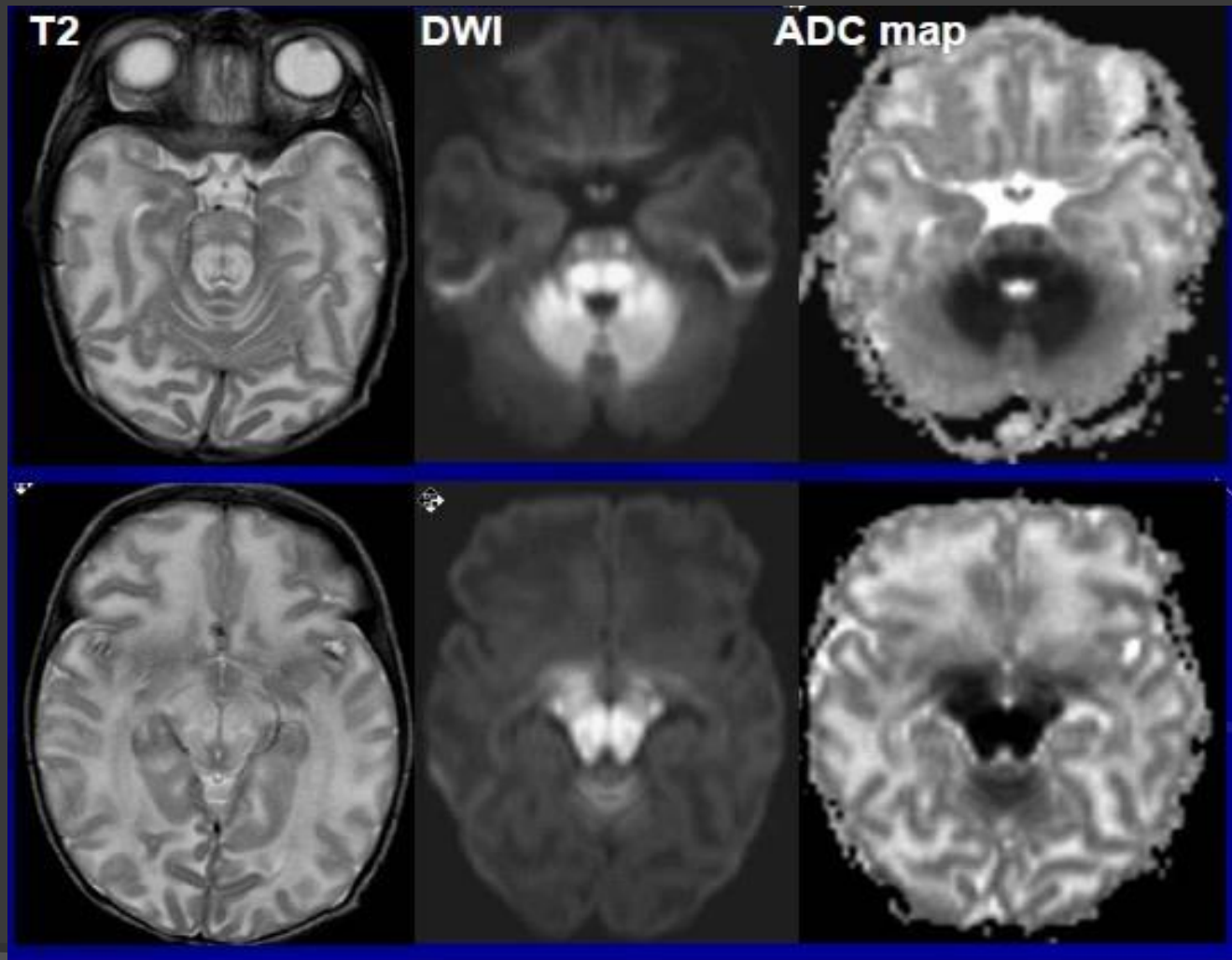
Deep cerebellar WM, dorsal pons, cerebral peduncles, internal capsule, deep cerebral WM



Involves early myelinated areas

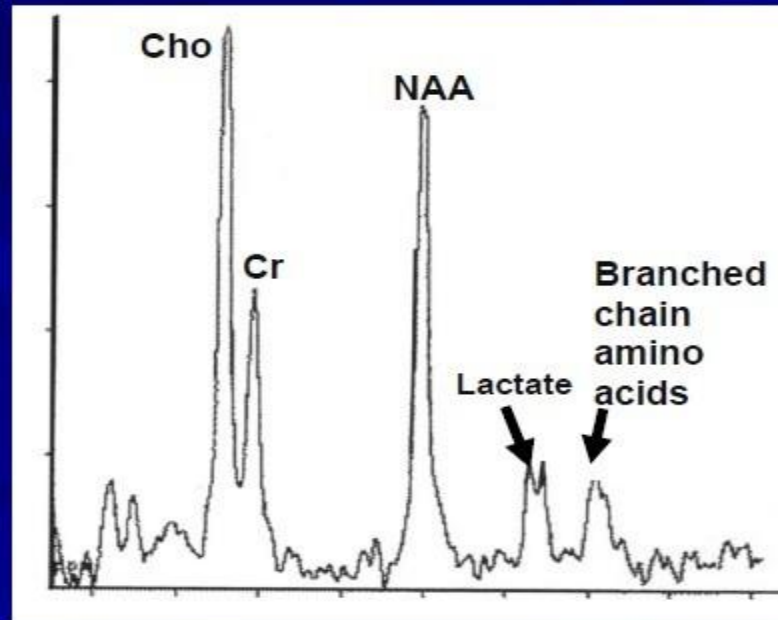
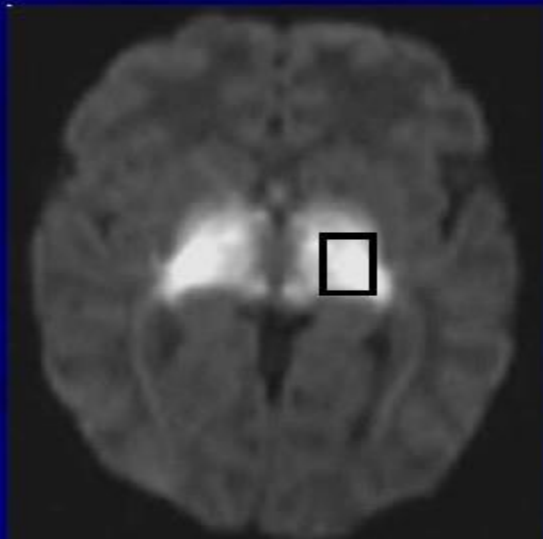


Restricted diffusion in the cerebellar WM, cerebral peduncles & dorsal horns.



MRS – Mild elevation lactate, abnormal methyl proton peak at 0.9ppm on both short t (30msec) and long echo (TE-270 ms) distinguishing them from the normal macromolecular peak that is seen only at short t TE !!!

■ **MRS: Lactate peak and branched chain amino acid peak**



METACHROMATIC LEUKODYSTROPHY

- └ Autosomal recessive.
- └ Def of enzyme arylsulfatase.
- └ Accumulation of galactosylceramide.
- └ MC hereditary leukodystrophy

- └ Sulfatides accumulate in brain, kidneys, liver, GB, peripheral nerves
- └ Dx: low AS in urine & peripheral blood

- └ Three types late infantile, juvenile and adult forms.
- └ Age of onset 1 to 2 years.

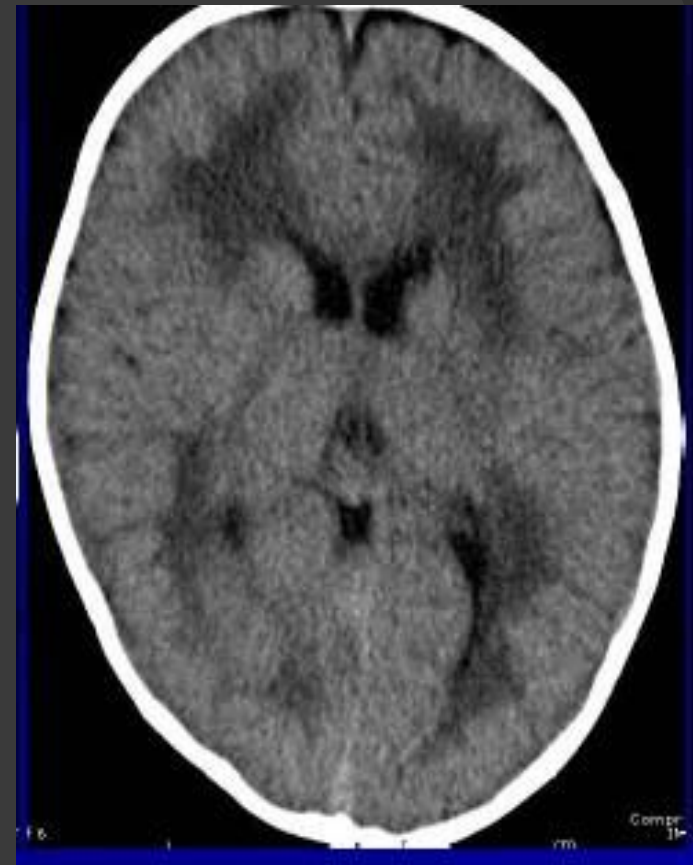
It typically involves the deep periventricular white matter sparing the subcortical white matter.

However late in the course both these areas are involved.

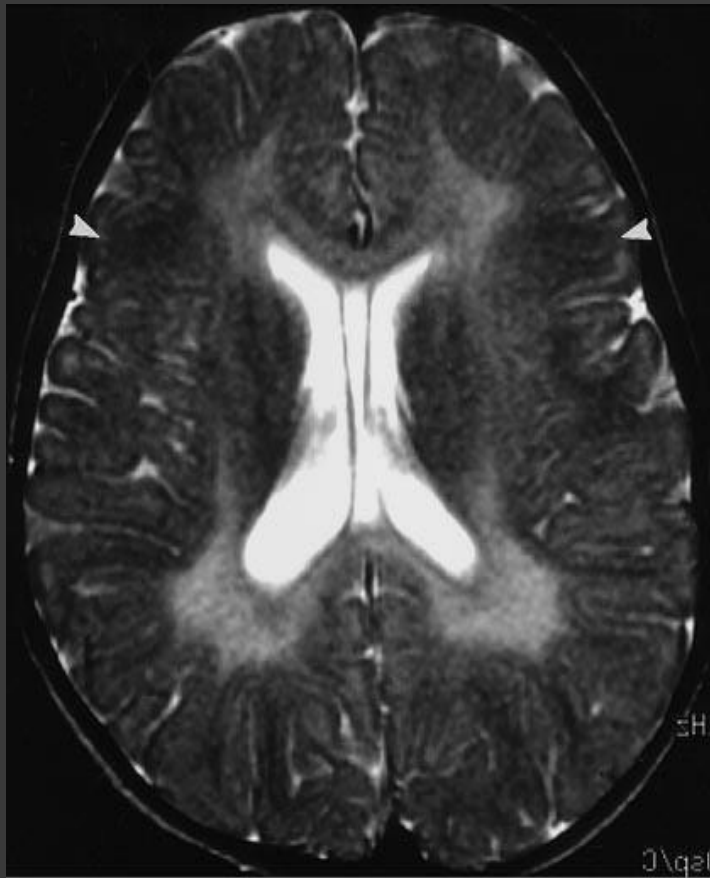
Clinical features of infantile form:

- Early motor signs of peripheral neuropathy
- Later deterioration of speech, intellect and coordination
- Death occurs 6 months to 4 years after disease onset.

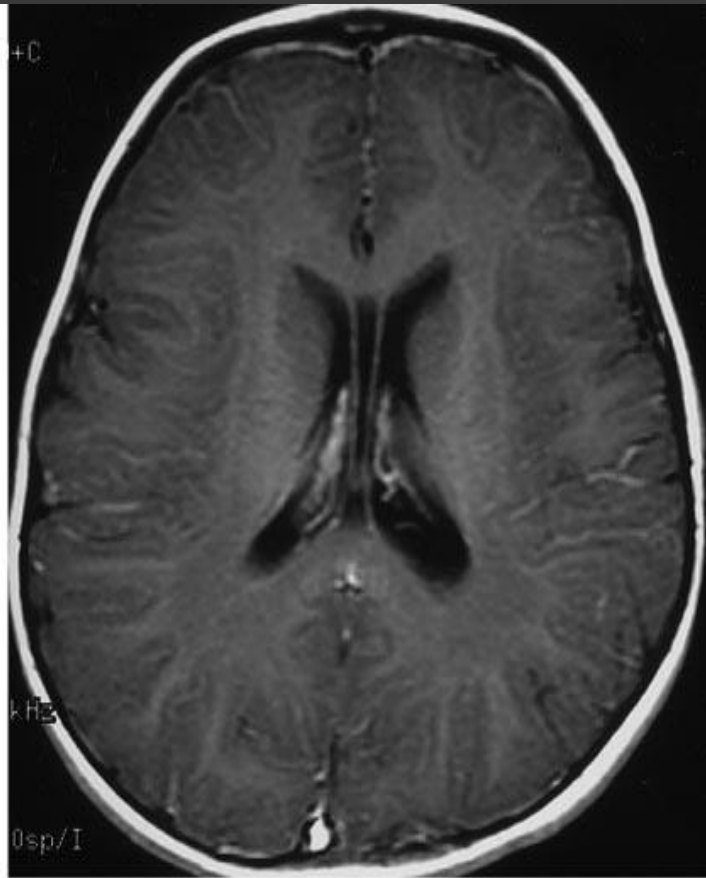
- CT
 - Moderate ventricular enlargement.
 - Hypodense lesions in periventricular regions, progressing anterior to posterior.
 - No enhancement on postcontrast study.



Deep WM, symmetric, confluent T2 hyperintensities with
no post contrast enhancement

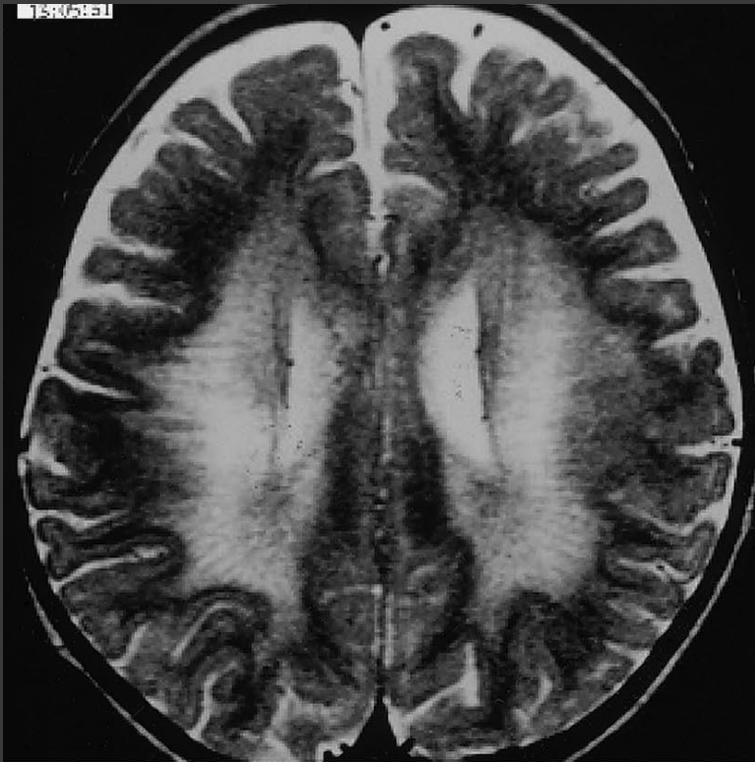


a.

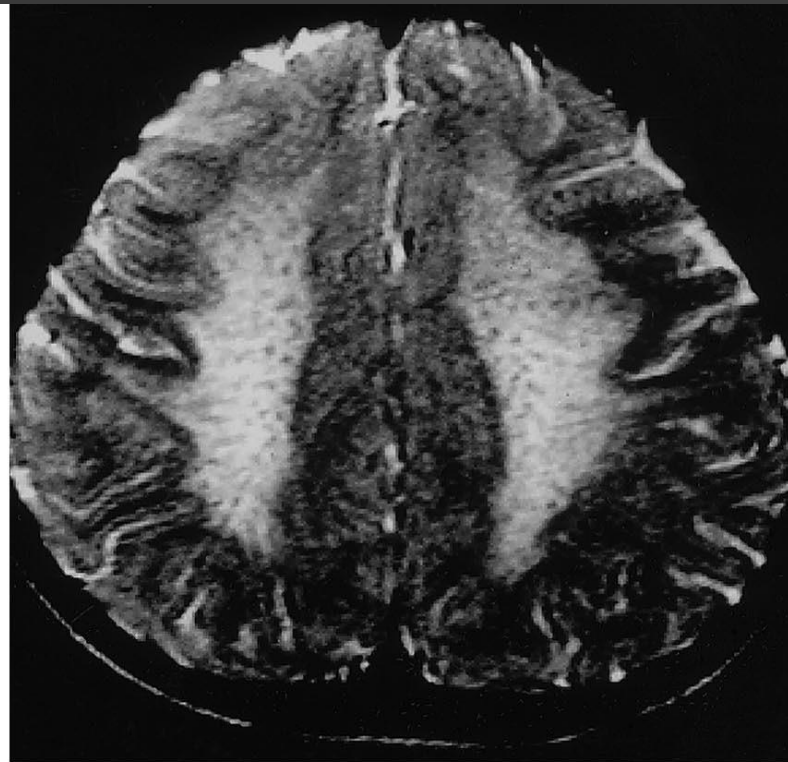


b.

T2-weighted MR images shows numerous linear tubular structures with low signal intensity in a radiating (“tigroid”) pattern within a sea of confluent hyperintensity : islands of normal myelin around medullary veins in WM !



a.



b.



a.



b.

involvement of the corticospinal tract. (a) T2-weighted MR image shows bilateral high-signal-intensity areas in the periventricular white matter with posterior predominance. The corpus callosum is also involved (arrows). (b) T2-weighted MR image obtained at a lower level shows involvement of the descending pyramidal tracts of the medulla (arrows) and deep cerebellar white matter.

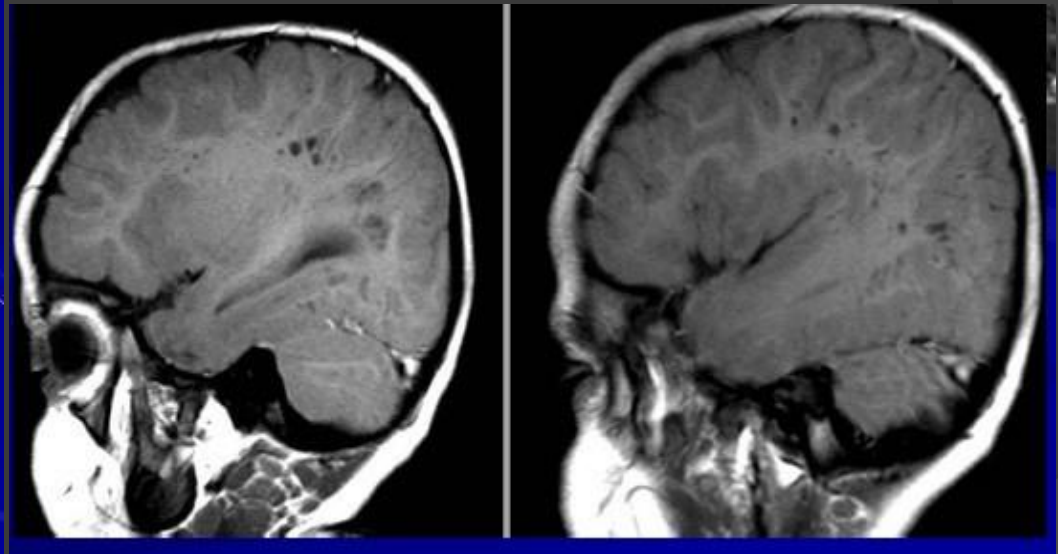
MLD : Pearls

- ❑ Progressive Symmetrical Centrifugal WMD.
- ❑ Frontal predominance.
- ❑ No CE
- ❑ CC, IC n DEEP WM are always and invariably involved.
- ❑ Hypointense Thalami.
- ❑ MRS : MYOINOSITOL

MUCOPOLYSACCHARIDOSIS

- Group of rare lysosomal enzyme deficiency disorders
- All involve metabolism of glycosaminoglycans
- **Imaging**: Delayed myelination, atrophy, hydrocephalus, cysts in periventricular WM, corpus callosum, basal ganglia
- Presentation, prognosis depend on specific disorder
- Hurler disease is most common

MRI: T2 deep WM bright signal, distended perivascular spaces.... Cysts



LOWE SYNDROME

- ❑ X linked, autosomal recessive
- ❑ Phosphatidylinositol-4,5-bisphosphate-5 phosphatase enzyme anomaly
- ❑ Involves brain, lens, kidneys
- ❑ Clinical findings:

Congenital cataracts

Glaucoma

Mental retardation

Renal tubular dysfunction (Fanconi syndrome)

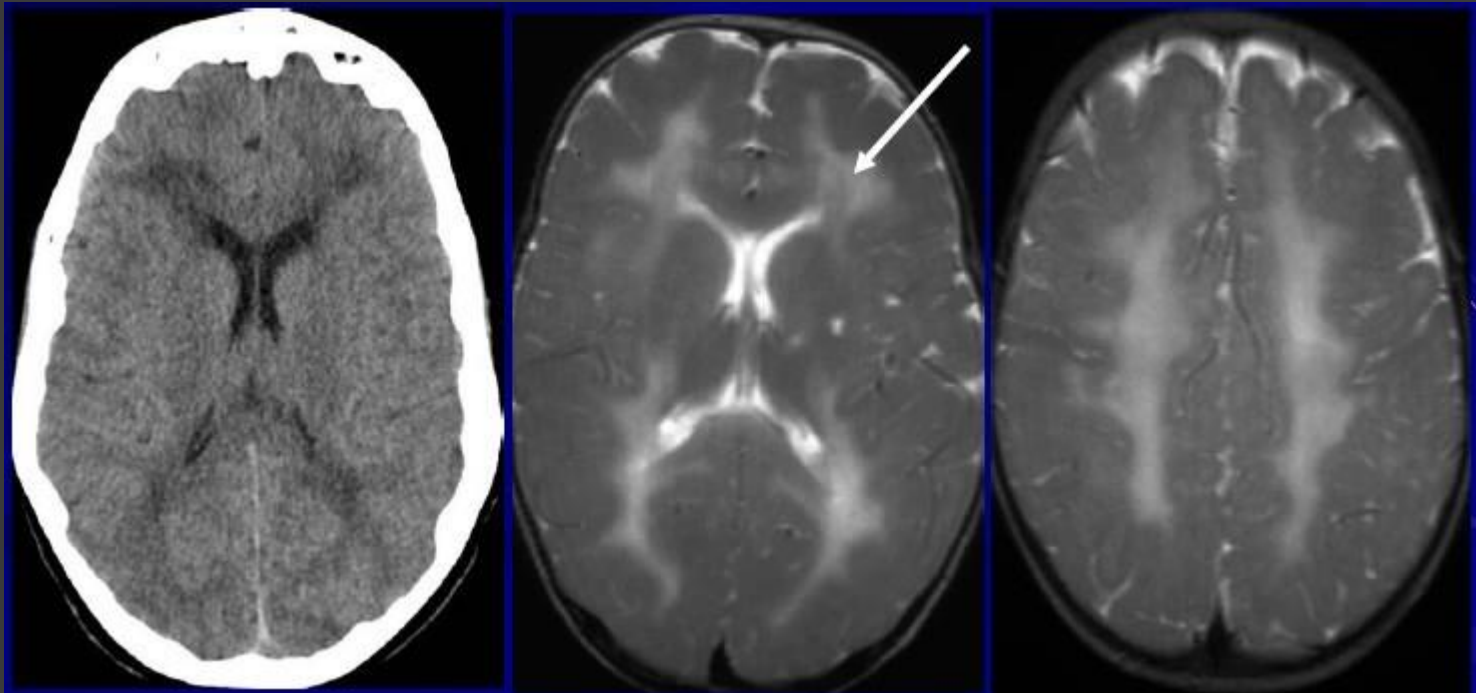
Metabolic bone disease

IMAGING FEATURES

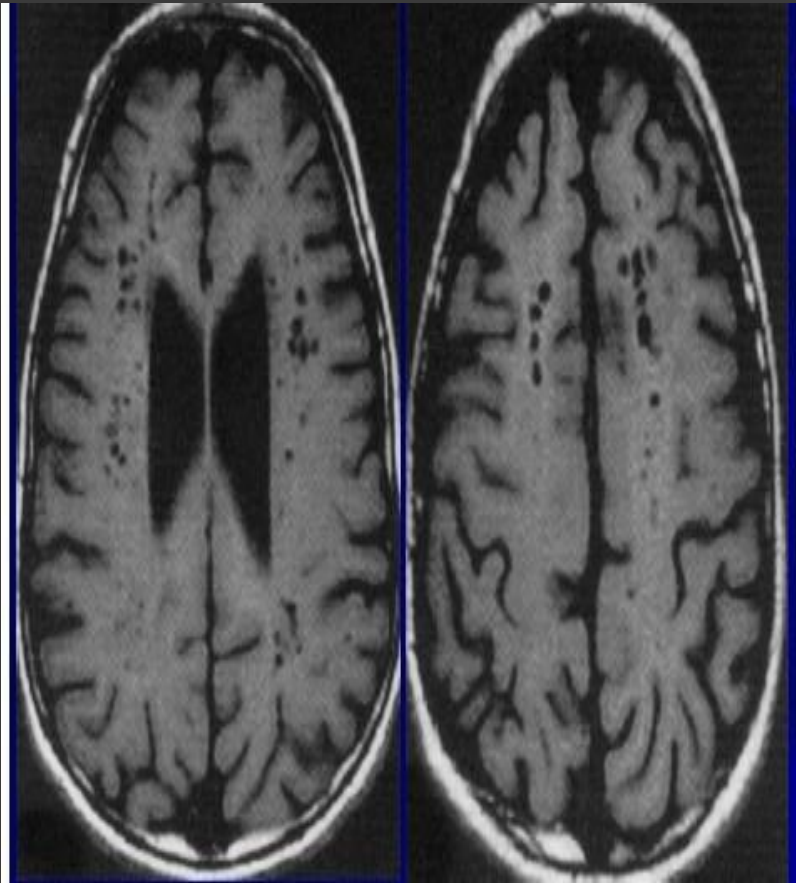
- ❑ **Bilateral, symmetrical deep WM low density on CT, with T1 and T2 shortening on MRI**
- ❑ **Cystic areas within abnormal WM**
- ❑ **Sparing subcortical U fibers**
- ❑ **MRS: Some cases elevation of myoinositol peak due to gliosis or enzyme accumulation**

CT: Nonspecific hypodense deep WM

MRI: Deep WM bright on T2 early



WM CYSTSON T1 CONGENITAL CATARACTS



CONGENITAL MUSCULAR DYSTROPHIES

- Heterogeneous inherited group of disorder resulting from mutation of lamina-alpha-2 gene on chromosome 6
- **Presentation:** Hypotonia & weakness from birth, possibly arthrogryposis, diminished deep tendon reflexes, normal intelligence
- Moderate elevation of serum creatine kinase

Major types (according to van der Knapp):

- **Fukuyama congenital muscular dystrophy**

Associated cortical dysplasia

- **Walker-Warburg syndrome**

Associated cortical dysplasia

- **Muscle eye brain syndrome**

- **Merosin deficient congenital muscular dystrophy (classic form)**

MDC1C – brain mostly normal

MDC1D – brain not normal

FUKUYAMA CONGENITAL MUSCULAR DYSTROPHY

- **Japanese**
- **Autosomal recessive**
- **Onset: infantile marked hypotonia, many ocular anomalies**
- **Imaging (findings are not specific):**

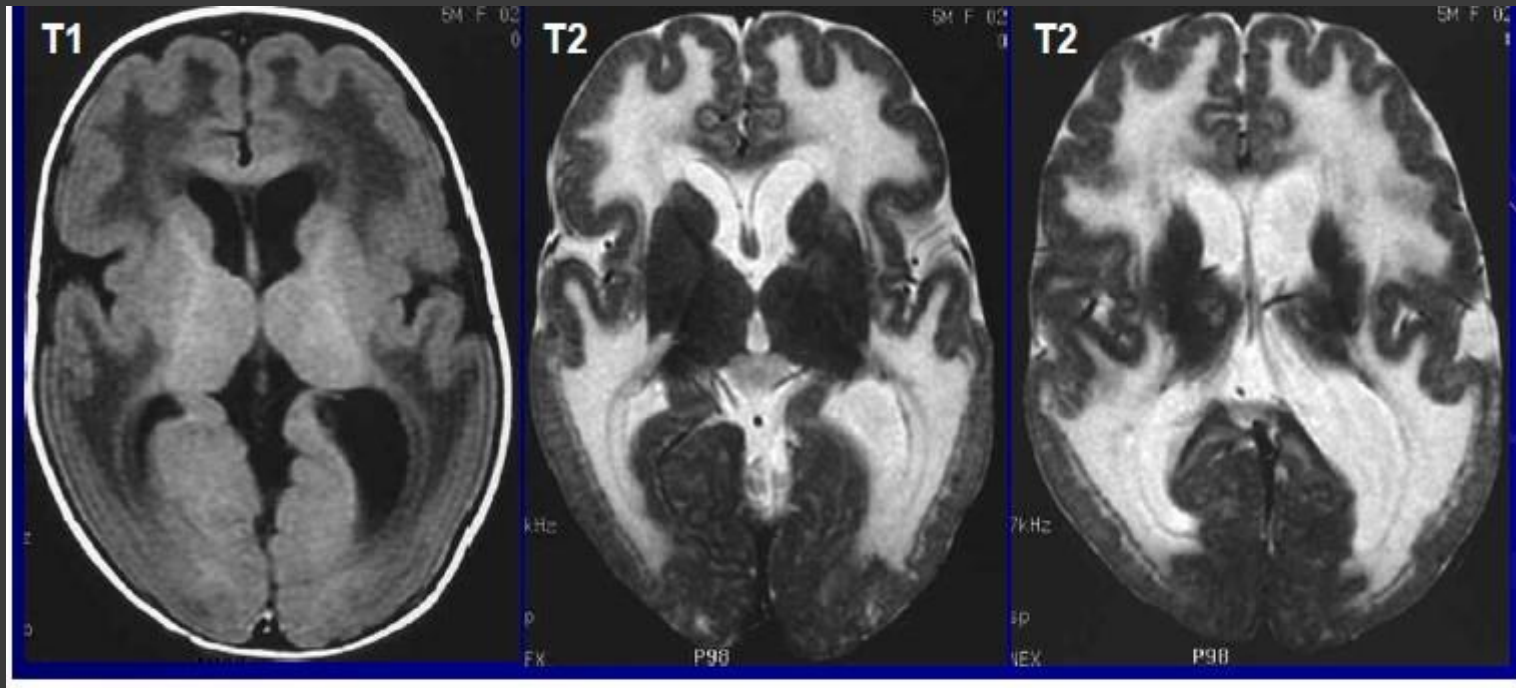
Diffuse cortical dysplasia

**Cerebellar cortical dysplasia &
subcortical cysts**

WM abnormal signal

Pons hypoplasia

CORTICAL DYSPLASIA, WM ABNORMAL

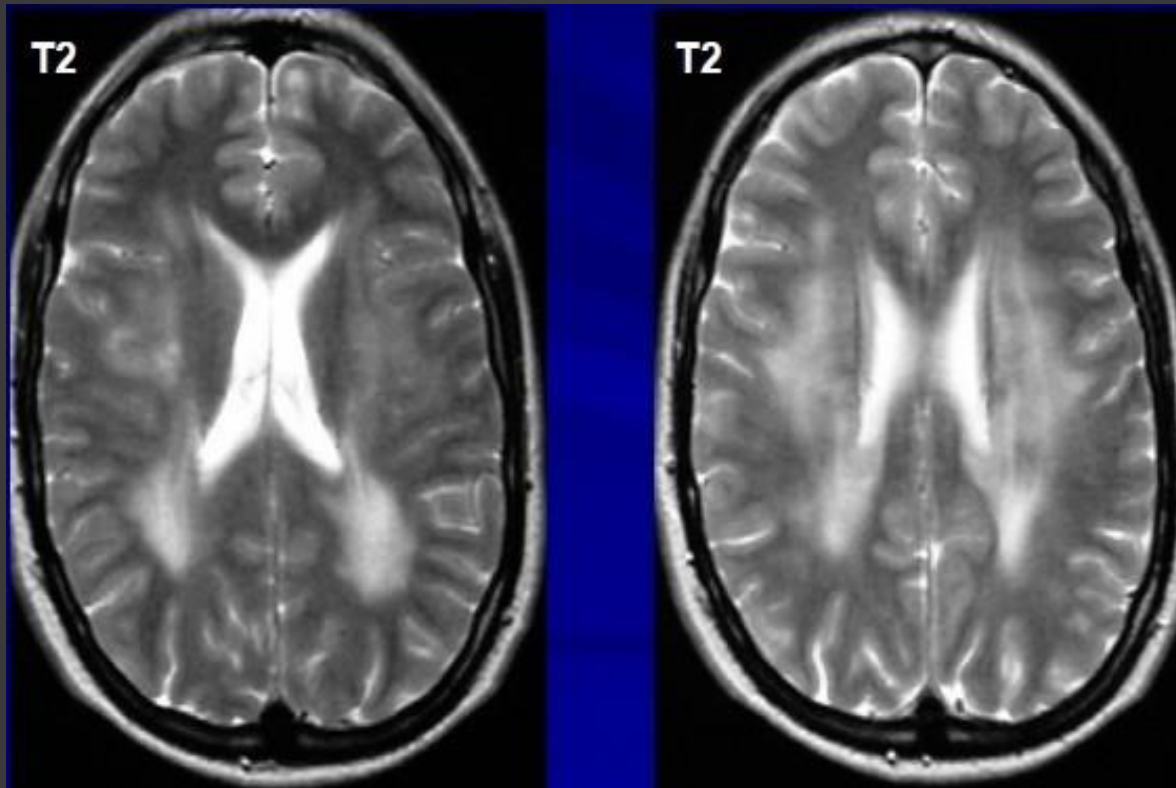


MEROSIN DEFICIENT MUSCULAR DYSTROPHY

**3 types of congenital muscular dystrophy
(according to Barkovich):**

- 1. Children with normal brains**
 - 2. Children with CNS symptoms, abnormal myelin & normal cortex**
 - 3. Children with CNS symptoms, abnormal myelin & cortical involvement**
- ☐ **Imaging: Delayed or hypomyelinated deep cerebral WM, with mild pontine & cerebellar hypoplasia**
 - ☐ **Dx: muscle biopsy, MRI & clinical evaluation**

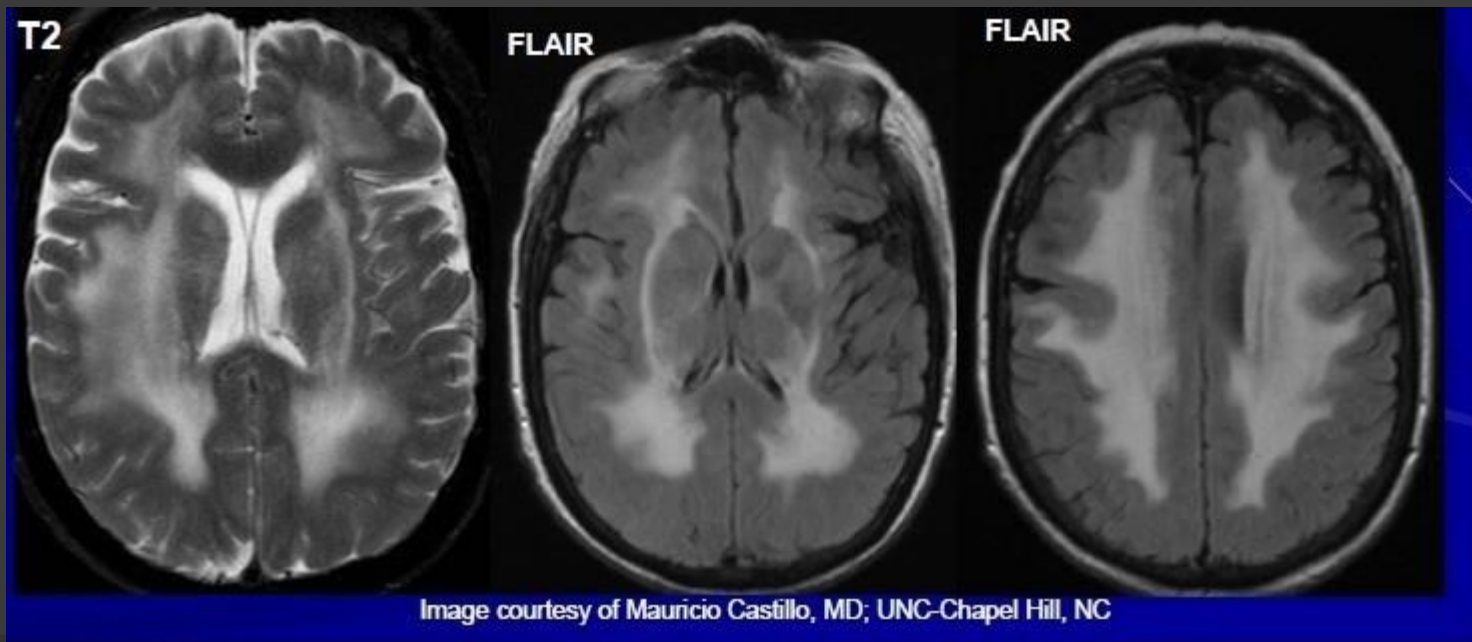
NON SPECIFIC T2 WM HYPERINTENSITY

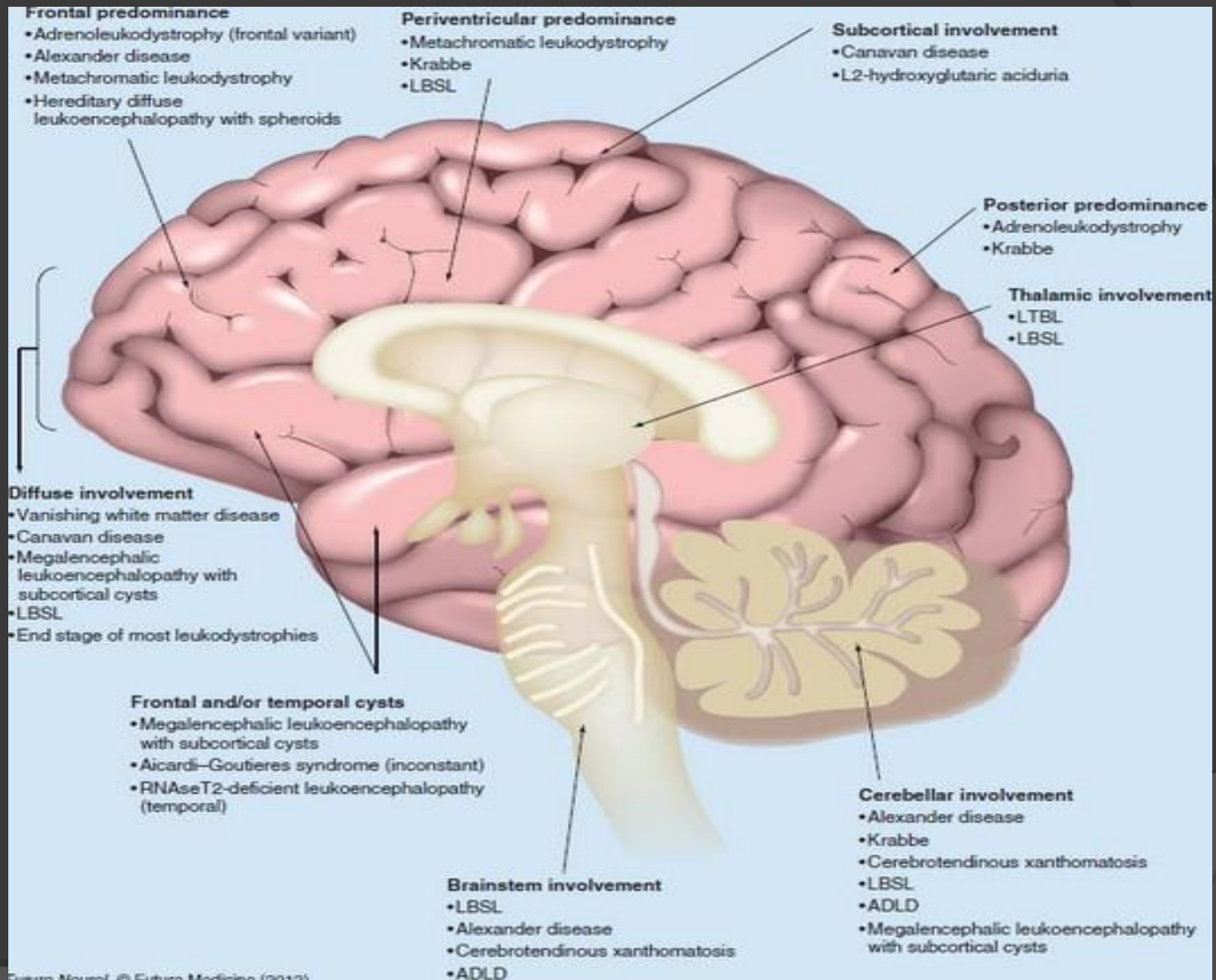


CMD WITHOUT MEROSIN DEFICIENCY

CT: Nonspecific deep WM & generalized atrophy

MRI: Lack of myelination without WM destruction





THANK YOU

